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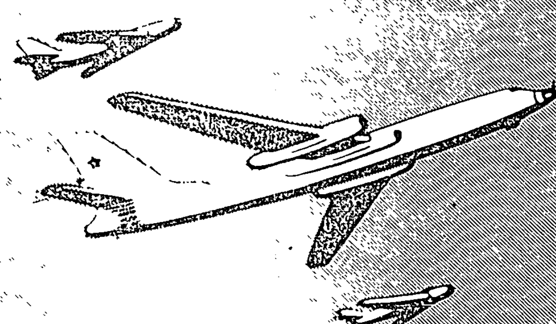
TRANSLATION

HERALD OF THE AIR FLEET



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EXPLANATORY NOTE

This publication is a translation of Herald of the Air Fleet, (Vestnik Vozdushnogo Flota) a monthly journal of the Soviet Air Force published by the Military Publishing House, Ministry of Defense, USSR.

Every effort has been made to provide as accurate a translation as practicable. Soviet propaganda has not been deleted, as it is felt that such deletion could reduce the value of the translation to some portion of the intelligence community. Political and technical phraseology of the original text has been adhered to in order to avoid possible distortion of information.

Users and evaluators of this translation who note technical inaccuracies or have comments or suggestions are urged to submit them to: Commander, Air Technical Intelligence Center, Attention: AFCIN-4B, Wright-Patterson Air Force Base, Ohio.

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AIR TECHNICAL INTELLIGENCE TRANSLATION

(TITLE UNCLASSIFIED)

HERALD OF THE AIR FLEET

(Vestnik Vozdushnogo Flota)

6

1957

AIR TECHNICAL INTELLIGENCE CENTER
WRIGHT-PATTERSON AIR FORCE BASE
OHIO

AF-WP-O-20 MAR 58 400

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REVIEW AND PUBLICATIONS

ON INTENSIFYING THE COMBAT READINESS OF THE SOVIET AIR FORCE

Hero of the Soviet Union, Lt. Gen. of the Air Force, S. I. Mironov

In 1933, the Soviet Government decided to observe Air Fleet Day annually. Since that time this holiday has served the purpose of widely popularizing the achievements of military and civil aviation among the toilers of the Soviet Union.

During the years of heroic labor, struggle, and victories of the Soviet People led and directed by the Communist Party, our Air Force has grown immeasurably. It is sufficient to call to mind that in the first air parades, universal rapture was aroused by aircraft that flew at a speed of 350-370 km/hr. The Soviet People were proud of such aircraft. And they were justifiably proud: for that time these were first-class aircraft.

In all stages of its development, Soviet aviation has been and is in no way inferior to that of foreign aviation. The slogan advanced by the Communist Party during the thirties — to fly higher, further, and faster than anybody — became a call to action for the entire personnel of the Air Force, for the Civil Air Fleet, for the designers, engineers, and workers of the aviation industry, and for the thousands and thousands of Soviet patriots through whose efforts the glory of our aviation has soared from year to year. But the Soviet Union, which had created a mighty Air Fleet, has never threatened anyone with force and has not been proposing to utilize it as a means of aggression.

In 1934, for the first time, the title of Hero of the Soviet Union was conferred upon seven brave Soviet men. They were: A. V. Lyapidevskiy, S. A. Levanevskiy, M. T. Slepnev, V. S. Molokov, N. P. Kamanin, M. V. Vodop'yanov, and I. V. Doronin. They were awarded the title of Hero of the Soviet Union for having performed a heroic deed in saving human lives — the crew of the ice-breaker "Chelyuskin".

The crew of the great Soviet pilot, V. P. Chkalov, covered itself with unfading glory by carrying out, in 1937, the first non-stop flight between Moscow and the United States of America over the North Pole.

"In carrying out the flight from Moscow to your country over the North Pole", said Valeriy Chkalov in a speech at a reception in honor of the Soviet flyers in New York, "we have borne a greeting on the wings of our plane from the one hundred and seventy millions of our people to the great American people ... And no cyclones, no polar storms were able to stop us, for we were fulfilling the will of our people".

That same year the brilliant flight from Moscow to the United States of America over the North Pole was repeated by a crew of Soviet flyers consisting of M. M. Gronov, S. A. Danilin, and A. B. Yumashev.

The flights to America in 1937 served not only as an indicator of the great achievements of Soviet aviation, but they contributed to a rapprochement between the two countries. The broad strata of the American people enthusiastically followed

Military Pilot First Class, Captain V.N. Shvetsov — one of the participants in the air parade of 1957.

these flights and were carried away by the bravery of the Soviet flyers.

The Soviet Union is a peace-loving state, aggressive aims are alien to it, and it presents no threat to other countries and peoples. But our people's love of peace is not a sign of its weakness. And when Hitlerite Germany thrust war upon it, it was able to defend the liberty and independence of the Socialist Motherland and utterly to defeat the Fascist invaders.

During the years of the Great Patriotic War, the Air Force, as a component part of the Armed Forces of the USSR, honorably carried out the tasks entrusted to it. Hundreds and thousands of fearless air fighters exalted the glory of our Air Force through their immortal deeds and were awarded many combat decorations. The elite were awarded the title of Hero of the Soviet Union.

Quite recently the glorious galaxy of aviators who are Heroes of the Soviet Union was increased by one more pilot who displayed limitless bravery, tenacity, and self-sacrifice in fulfilling his duty to the Motherland. His name is Leonid Georgiyevich Belousov, a former fighter-pilot in the Baltic Fleet.

All told, during the years of the Patriotic War, L.G. Belousov carried out 298 combat sorties. There are 30 aerial engagements to his credit, and 3 enemy aircraft which he personally knocked down. He successfully carried out combat assignments and 10 times conducted aerial engagements even after both his legs had been amputated. What a will to fight, what boundless love for the Motherland are needed for a man to remain in combat formation under such circumstances!

When we speak of the exploit of this Soviet man, each of us is aware that his bravery and tenacity, his spiritual force, his unsurpassed moral qualities are not something exceptional. The source of these qualities is in the clarity of the recognized goal, in the great justice of the cause for which Soviet men and women are fighting.

Heroism has always been inherent in the Russian soldier. But the heroism of Soviet fighters who have developed and increased all that was best and characteristic of the Russian Army is a qualitatively new phenomenon, insofar as it is based on the most advanced social and state system. Soviet patriotism, the moral and political unity of all members of Socialist society, and the friendship among the peoples of the USSR give rise to the entire system of indoctrinating each soldier of our army in the spirit of loyalty to his duty, of constant readiness to defend his Motherland to the last drop of blood, bravely and ably, with dignity and honor.

During the years which elapsed after the end of the Great Patriotic War our country took a tremendous step forward along the path of building Communism. Everywhere — in building and industrial enterprises, in the laboratories of scientists and in the kolkhoz fields — inspired creative work is in full swing. With tremendous enthusiasm Soviet men and women are struggling to translate into reality the resolutions of the 20th Congress of the CPSU, the decisions of the Party and of the Government aimed at achieving a new steady upsurge in all branches of the socialist economy, at making our Motherland even more beautiful and happier.

Throughout the entire country nationwide socialist competition has rallied to a worthy welcome for the 40th anniversary of Great October. The broad masses of the people are firmly resolved to fulfill the national economic program of the second year of the sixth five-year plan ahead of schedule, to increase agricultural production considerably, to improve the administrative organization of industry and construction, and to mark the glorious jubilee in the life of the Soviet State with new victories.

Against this background of nationwide political and labor upsurge, Soviet men and women are observing a traditional holiday — USSR Air Fleet Day. Thanks to the tireless concern of the Communist Party and the Soviet Government, our glorious Air Force has grown immeasurably in all its basic features: flight speed, range, and altitude.

The Air Force is supplied with the most modern jet combat equipment. Modern high-speed fighters and bombers are outfitted with perfect equipment and instruments, which make it possible to carry out a long-range flight in the stratosphere, by day and by night, under any weather conditions. This is to the credit of Soviet scientists, aviation designers, test-pilots, and also engineers, workers, and employees of the aviation industry. On May Day, by an Order of the Presidium of the Supreme Soviet of the USSR, the title of Hero of the Soviet Union was conferred upon N. G. Alifanov, A. G. Vasil'chenko, S. D. Golovachev, L.I. Minenko, M. A. Nyukhtikov, N. S. Rybko, G. A. Sedov, and other test pilots for heroism and bravery manifested during test flights in modern jet aircraft.

In the Air Force of the USSR splendid cadres have grown, of Air Force commanders, military pilots, navigators, engineers, technicians, and junior aviation specialists. Straining every effort to the full, they are working indefatigably to master perfectly the highly complex equipment that has been entrusted to them.

Repeatedly during the postwar years, numerous spectators at the air parades have warmly applauded Military Pilot First Class V. S. Lapshin. This year, the high honor of opening the military part of the air parade, i. e., of demonstrating to one's people that which has already been achieved and consolidated by Soviet military pilots, has fallen to the lot of Captain V. N. Shvetsov — one of the representatives of the Soviet Air Force, one of the expert pilots who are faultless masters of their combat weapons. In our units there are many such experts in aerobatics and air combat, sniper gunnery, and precision bombing.

The aviation engineers, technicians, and junior aviation specialists have managed no less successfully to cope with their responsible work. Thus, through their self-sacrificing work, they guarantee the reliable, dependable operation of the Air Force in the air.

Officer F. T. Kharisov has been working a comparatively short time as deputy commander in the Air Force Engineer Service, but he has already mastered well the technical operation of new equipment. An outstanding methodologist, he organizes properly the training of the flying and technical personnel of the unit and actively participates in efficiency promotion and social work.

Our Air Force commanders organize the training and orientation of their men skillfully. Constantly relying on the Party and Komsomol organizations, they mobilize their entire personnel for exemplary fulfillment of their service responsibilities and for maintenance of the strictest military discipline and order. Efficient organization of training, high exactingness on the part of the commanders who strive for an exact and steady observance of all the rules of flight service, are the most important conditions for conducting intensive flight activity without accidents. Among our best commanders who, over a number of years, have been achieving the fulfillment of flight training schedules without crack-ups or crashes, we may mention officers I. I. Yefrenov, A. P. Ped'ko, A. I. Ageyev, and many others.

In the personnel of the Air Force there are thousands upon thousands of outstanding men in combat and political training. They are all genuine Soviet patriots, who, through their self-sacrificing work, have been increasing the combat might of military aviation. To them, service to their Socialist Fatherland, to their people, to the Communist Party and the Soviet Government are above all else.

On Air Fleet Day, not only the personnel of the Air Force, but also the pilots and aviation specialists of the Civil Air Fleet, workers of the aviation industry, youth active in DOSAAF [Voluntary Society for Cooperation with the Army, Aviation, and the Fleet] report to the people about their achievements.

The Civil Air Fleet of the USSR now carries out the most varied tasks in the development of the country's national economy. Tens and hundreds of GVF [Civil Air Fleet] air lines unite the most remote corners of our Motherland into a single whole, and communications are regularly carried out along international air lines. Aviation finds broadest application in agriculture, and carries out important functions, such as medical, transport service, etc. In air clubs and numerous circles of DOSAAF, our youth — future pilots, glider pilots, parachutists, aviation designers — carry out their initial training.

With complete justification and a rightful sense of pride, we say that our Motherland is a mighty air power and we are proud of the fact that the great leader of the working class, V. I. Lenin, stood by the cradle of Soviet aviation.

In April 1957, outstanding achievements in the field of science and technology, literature and art, were marked by awards bearing the name of Lenin. Among those who were awarded this high distinction for their creative work are also representatives of Soviet aviation. One of them is the prominent designer, Andrey Nikolayevich Tupolev, Academician, and Designer General of the aviation industry. He became Lenin Prize Laureate for his creation of the highspeed jet passenger plane TU-104. Mikhail Grigor'yevich Surgutanov, pilot of the air party of the Ural Geological Administration, was awarded the Lenin Prize for his discovery and prospecting of an iron ore deposit of the Sarbay and Sokolov groups in Kazakhstan.

We Soviet men and women are full of new designs and plans, we do not need war. But we cannot help but take into account the provocative intriguing of the aggressive imperialist forces who are feverishly preparing for war against the Soviet Union and the countries of people's democracy, intensifying the armament race, organizing aggressive blocs, strengthening their military bases in direct proximity to our borders, and creating reserves of atomic and hydrogen weapons.

The Soviet Union cannot help but take all this into consideration. The Communist Party and the Soviet Government, while systematically pursuing a policy of peace, are tirelessly concerned for the further strengthening of the defensive capacity of our state. The forces of aggression and war are confronted by the powerful Socialist camp, the countries of which, headed by the Soviet Union and the Chinese People's Republic, are united by bonds of indissoluble friendship and brotherhood. Those who love military adventures must know that there is no corner in the world right now where an aggressor could take cover. The Soviet Air Force is capable of inflicting crushing blows upon any enemy wherever he may be.

In view of present-day conditions, when the imperialist fomenters of war are bending every effort to aggravate the international situation, the Party and the Government demand of Soviet soldiers, vigilantly standing guard over the peaceful creative

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work of our people, even greater vigilance and further uninterrupted intensification of combat readiness. Not for one minute must it be forgotten that the high combat power of the Soviet Armed Forces is the reliable guarantee of peace in the entire world.

"In training our troops", says Minister of Defense, Marshal of the Soviet Union G.K. Zhukov, "we must assume the fact that our probable enemies have an adequate amount of these weapons and the facilities for delivering them to our territory. This circumstance obliges our Armed Forces, particularly the AA defense of the country, and the Air Force to be ready at all times to stop any attempt by an aggressor to carry out a sudden attack upon our country".

All this requires the personnel of the Air Force to maintain constant and high combat readiness in every crew, element, and unit. Complacency and carelessness, resting on one's laurels, cannot be tolerated in our midst. The primary duty of the Air Force commanders of all ranks, of the political workers, and of the Party and Komsomol organizations, lies in persistently continuing the struggle, without abating our efforts even for a minute, to train our flyers thoroughly in carrying out the most complicated missions.

From now on as well, we must struggle persistently to master flying in modern combat formations at high altitudes and speeds, under adverse weather conditions, at night, over great distances, and to learn to deliver running bombing attacks on unfamiliar bombing ranges.

In order to utilize modern aircraft in accordance with all the rules of skill and to take from equipment all that it can yield in accordance with its flight and tactical characteristics, every crew must master deep theoretical knowledge and solid habits in the practical field of aviation.

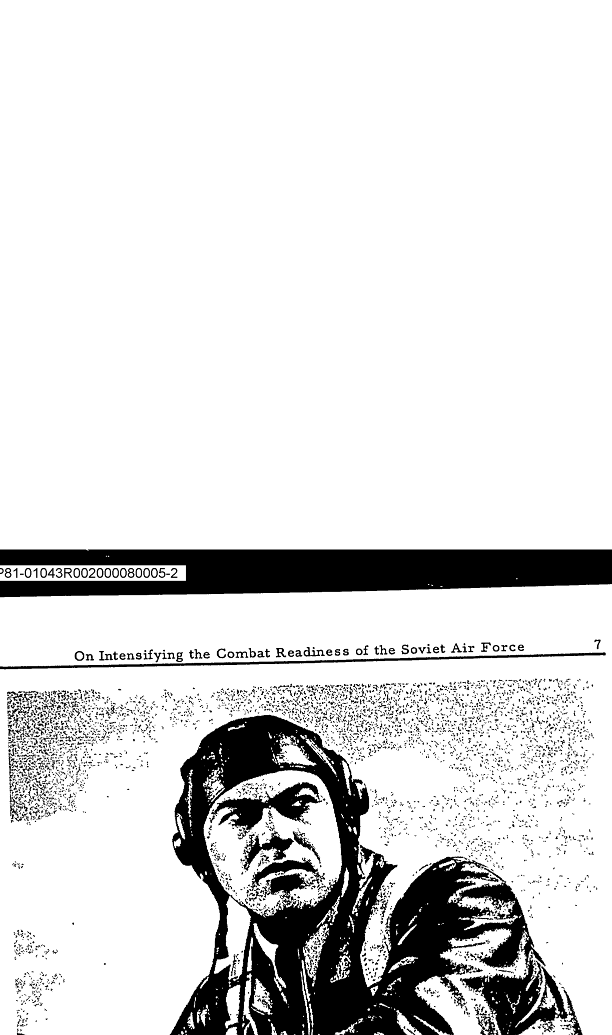
In this connection, the great significance of military scientific work in the VVS [Air Force] must be emphasized over and over again. This work contributes to a great extent to the development of our military theory and exerts direct influence upon the intensification of the combat readiness of the Air Force.

It is no secret to anyone that aviation equipment is being constantly perfected and modernized. Certain types of aircraft are replaced by others with even higher flight and technical characteristics. Consequently, the commanders, the flying and technical personnel, and all the specialists cannot but look ahead as they carry out current schedules of combat training operations; they must prepare themselves for the equipment of tomorrow. The military science societies being formed in our units and groups will undoubtedly play a great role in the solution of this problem, if the work in them is organized and is conducted in a well-thought-out and purposeful manner.

A deep and perfect familiarity with equipment, the ability to operate it competently under any conditions, is the task of primary importance towards the solution of which much work yet remains to be done.

We must constantly develop and advocate among our pilots, navigators, engineers, and technicians a spirit of innovation, an invaluable feeling for the new, which does not let our cadres grow stagnant but carries them irresistibly forward to new heights of skill, to active creative work for the welfare of the Motherland.

We have always said that combat readiness in Air Force units depends to a very considerable extent on the correct formulation of political and indoctrination work. An important task of the commanders and of the party-political apparatus is to incul-



Military Pilot First Class V. S. Lapshin cate in our flyers every day a high political awareness and ideological conviction and to enhance their knowledge of theory. Party-political work must be organized in such a way that ideological and theoretical indoctrination is organically connected with practice. We must imbue our personnel with high qualities of combat morale to surmount difficulties in a situation which excludes any oversimplification or laxity. Experience testifies rather convincingly to the fact that high results in combat training are possible only where men do not fear difficulties but boldly overcome them, without, at the same time, departing in any respect from the established rules of flight service.

Relying on the support of the Party and Komsomol organizations, the Air Force commanders are called upon to reach general conclusions in a well thought out manner and to disseminate the experience of their foremost men, and to be organizers of Socialist competition. All flyers must be actively included in the struggle for the training of outstanding pilots and for an everincreasing number of outstanding crews. The more specialists — first class experts in their profession — there are in the Air Force, the higher will be our combat readiness.

At the basis of methods for training and indoctrinating a bold pilot who knows his job lie such fundamental principles as a consistent transition from the simple to the complex, an individual approach to every man, the personal example of the commander, and a mandatory and well-reasoned analysis of errors committed during the carrying out of some mission or other.

During the course of ground training, the pilot must prepare himself thoroughly for carrying out his flying mission. In classes he daily broadens his knowledge in the field of equipment and tactics, aerodynamics, navigation, studies the nature of the forthcoming flight, and analyzes typical errors which arise during the working out of a regular exercise. Moreover, flying personnel is regularly trained in the cockpit of an aircraft.

Thus, every flight is preceded by prolonged and painstaking work. It is fully understandable that the better the exercises are thought out and instructively organized, the better and more fruitful are the results of such work. The commander must know his work very well and love it in order to avoid formalism and routinism in organizing the training of his men, in order to arouse their genuine interest, and, in every exercise, to add something new, something useful to their knowledge.

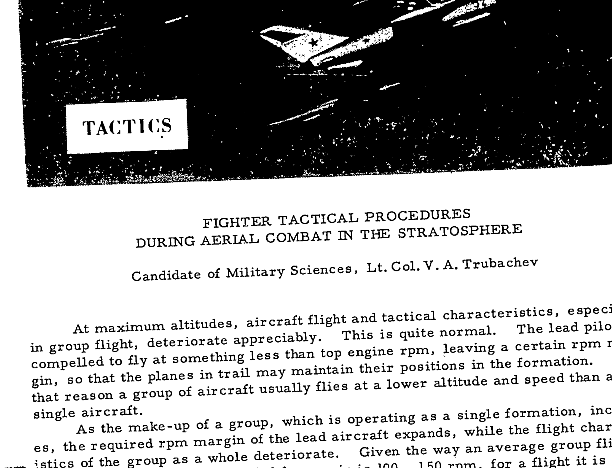
Recently an "Honor Book" was set up by order of the Commander in Chief of the Air Force. The unit commander, the head of the school, was given the right to enter in it the names of soldiers, cadets, sergeants — outstanding men in combat and political training — who had achieved exemplary results in training and the highest ratings in socialist competition, men who are faultlessly disciplined and also especially outstanding in carrying out their military duty.

The "Honor Book" is an important means of indoctrination which must be skillfully utilized by the Air Force commanders for the further encouragement of their outstanding men in combat and political training, and for the transmission of their experience and traditions to young soldiers and cadets. The more broadly and intelligently all forms of indoctrination work with the men are applied by the Air Force commanders and political workers, the higher will be the combat readiness of our units and elements.

An important criterion in evaluating the combat readiness of Air Force elements and units is the state of military discipline: exemplary organization and order, and the

LENIN PRIZE LAUREATE

Designer General of the Aviation Industry, Academician A. N. Tupolev outward bearing and inner poise of the soldier, sergeant, and officer. Only under the conditions of strictest adherence to regulations and discipline, can we speak of the capacity of the personnel to carry out honorably the tasks which face the Air Force elements and units. The duty of every aviator is to work selflessly at his post, thus strengthening the combat might of the Soviet Air Force.



FIGHTER TACTICAL PROCEDURES DURING AERIAL COMBAT IN THE STRATOSPHERE

Candidate of Military Sciences, Lt. Col. V. A. Trubachev

At maximum altitudes, aircraft flight and tactical characteristics, especially in group flight, deteriorate appreciably. This is quite normal. The lead pilot is compelled to fly at something less than top engine rpm, leaving a certain rpm margin, so that the planes in trail may maintain their positions in the formation. For that reason a group of aircraft usually flies at a lower altitude and speed than a single aircraft.

As the make-up of a group, which is operating as a single formation, increases, the required rpm margin of the lead aircraft expands, while the flight characteristics of the group as a whole deteriorate. Given the way an average group flies together, the rpm margin provided for a pair is 100 - 150 rpm, for a flight it is 200 - 250 rpm. It is true that sometimes the leader flies at top engine rpm. But even then the flight characteristics of a group are inferior to those of a single aircraft, since the leader must apply the speed brakes from time to time in order to allow the planes in trail to formate on.

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In order to determine certain special features of fighter group flight at high altitudes, let us examine the effect of the leader's reduced engine rpm on the group's ceiling. For the sake of convenience, let us use the thrust reserve as a starting point.

Let us assume that at a certain altitude, a 150 rpm reserve for a fighter equals approximately 30 kg of thrust, and a 250 rpm reserve equals 50 kg of thrust.

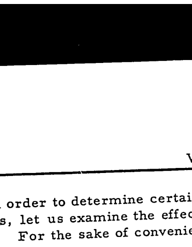
Fig. 1. Pair in formation, echeloned to the rear and down.

As the altitude increases, the thrust reserve for horizontal flight decreases, and, at some definite altitude, becomes equal to zero, which fact determines the ceiling of the single aircraft.

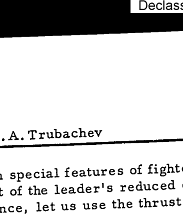
Let us assume that in a pair the wingman must have a 30 kg thrust reserve; while the leader's rated thrust P_r will equal 375 kg, his available thrust P_a for the desired altitude will equal 405 kg. The wingman's rated and available thrust at this altitude will be identical and will come to 405 kg. Only the last plane in the formation will fully utilize the engine thrust, and even then, only from time to time. Therefore the wingman determines the pair's flight altitude, and of course he cannot fly at a highter altitude than his leader.

An analysis of the flight conditions of the pair's leader shows that it is feasible to raise the pair's ceiling to that of a single plane. This is achieved by using a special formation pattern. If the leader, maintaining his speed, utilizes the reserve thrust to increase flight altitude, then his wingman will have a thrust reserve for maintaining his position in formation while flying at the original altitude. (Fig. 1).

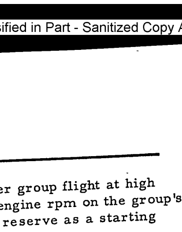
TEST PILOTS
HEROES OF THE SOVIET UNION



N. G. Alifanov



N. N. Arzhanov



B. N. Biryukov

This happens because, with a change in altitude, the available engine thrust alters more rapidly than the rated thrust.

In order that the wingman may observe the leader he must see him at an angle

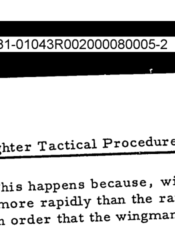
Fig. 2. One version of pair teamwork and wingman's repulse of enemy attack.

of no more than 30-40° upwards or laterally. With a 500 m difference in altitude, the wingman will be located at a distance of 850-600 m.

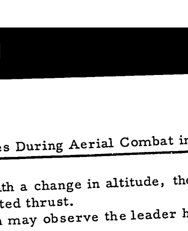
Analogously, in a flight formation, the lead pair will be able to operate at the ceiling of an independent pair, while the pair in train will be able to operate at the ceiling of the flight. Thus by flying in an echelon, stepped to the rear and down, it is possible to raise the ceiling of a fighter group.

Formations echeloned to the rear and down can be used at lower altitudes, when

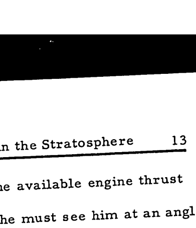
TEST PILOTS
HEROES OF THE SOVIET UNION



A. G. Vasil'chenko



V. P. Vasin



B. K. Galitskiy

flying under conditions of maximum speed and rate of climb, and — which is particularly important — with the afterburner cut in. In such cases the performance characteristics of the group are improved, and the conditions for maintaining their position are facilitated for those in train.

The formations, echeloned to the rear and down, which are being discussed, are usually determined by the general capabilities of group flight under such conditions. And it is quite understandable that fighter operations in such formations may only be compared with the operations of single aircraft, since in any other type of formation the flight altitude (or speed) decreases, excluding group operations under the established flight regime. However, notwithstanding, there exists a number of tactical methods involving effective teamwork between fighters — methods which justify the use of the indicated formations.

Let us examine the sequence of interaction within a pair in case the leader is threatened with an attack (Fig. 2). Maneuvering with loss of altitude, he will force the enemy either to decline the attack or to assume a position advantageous for attack by the wingman. Having eliminated the threat, and having taken advantage of the resulting speed increment during loss of altitude, the leader will be able to quickly reestablish his former altitude.

Let us take another example of teamwork where it is necessary to attack an enemy plane flying at the same altitude as the leader. In this case the wingman can quickly reach the altitude of the hostile aircraft and attack it at adjusted speeds trailing the leader, having gained altitude by zooming at the cost of some loss in speed.

The advantage of an attack at adjusted speed and at close range consists in an increase in probabilities of direct hits: the fire effectiveness of fighters increases appreciably. In stratospheric aerial combat with a bomber, fighters are faced with the problem of the former's certain destruction in the shortest possible time and during the very first attacks, since any single aircraft may turn out to be the carrier of an atomic weapon.

In order to solve this problem successfully, it is necessary either to increase the number of successively attacking fighters or to improve the effectiveness of the attack. It is possible to maximize the effectiveness of the attack on the bomber by approaching the target at minimal range (300-500 m), and by adjusting the speed at this range and conducting aimed fire.

But we cannot overlook the fact that attacks at adjusted speed have shortcomings as well.

In aerial combat with a bomber, the fighter will be subjected to fire from the former's weapons. Danger is further increased by the fact that in the stratosphere the fighter enters the firing position at low close-in speeds where he remains for some time. Therefore, in the course of an attack at adjusted speeds and close ranges, it is expedient to protect the fighter entering the firing position from the bomber's fire.

A preliminary attack, made by another fighter which has a speed reserve and which operates at a greater range, may serve as one such tactical maneuver for protection. In this case the maneuver of both fighters must be so set up that the plane attacking at adjusted speeds will occupy the firing position at the very moment the preceding fighter withdraws from the attack. In other words, the fighters attack successively: the first fighter, having a speed reserve, makes a relatively cursory attack,

while the second, so to speak, lingers in the firing position and blasts the enemy at close range.

The attack by the first fighter does more than support operations by the second. It is executed with the intent to destroy; with this in mind, the pilot should make his final approach with the most advantageous heading. The attack must be initiated at the maximum possible range and terminated at the minimum range.

Thus, combining these two types of attack, the bomber's effective counterfire may be reduced.

In the course of an attack at adjusted speeds, the technique of making the initial approach to the firing position is rather complex. The fighter, approaching to a distance of 300-500 m, must be traveling at the same speed as the target. However, in order to close in on the target from the rear hemisphere to this range, the fighter must have a speed advantage. In order to insure the element of surprise, the pilot endeavors to minimize the time lapse between the moment he spots the target and the moment he initiates the attack. For this reason, in the course of closing in he must have a great speed advantage over the enemy.

The maneuver in the stratosphere for reducing speed by cutting the engine rpm and by letting down the speed brakes must be started at long range. Thus, at a given altitude, with the enemy flying at 700 km/hr. and with the fighter — attacking from the rear hemisphere — flying at 900 km/hr., the fighter begins braking 3 km away in order to adjust his speed at a 500 m range, and he will close in within 88 sec.

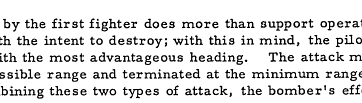


Fig. 3. Schematic diagram of a successive attack on a target by a pair of fighters (lead plane attacks with a speed reserve, while plane in trail attacks with a speed adjusted to that of the enemy).

The extensive time lapse necessary for reducing the speed of the fighter attacking at adjusted speeds precludes a preliminary attack on the part of the other fighter who has a speed reserve, since in this case the latter must overtake the first fighter as he approaches his own firing position. The time required for reducing speed can be shortened by resorting to zooming.

As can be seen in Fig. 3, in the course of closing in, both fighters travel at the same speed in echeloned formation.

The lead plane attacks the target in the usual manner at long range and with a speed reserve. The plane in trail, traveling at a lower altitude, and with a certain interval, duplicates the former's maneuver for convenience of observation. Having closed in on the enemy to a distance of 500-600 m, he zooms, and then attacks with a speed adjusted to that of the enemy. In order to avoid the backwash of the bomber's engines, the attack must be executed 150-200 m below the bomber.

When zooming under constant engine operating conditions the value of the gained altitude as a function of the loss in speed is determined approximately by the formula:

$$\Delta H = \frac{V^2_{beginning} - V^2_{end}}{9.81 \cdot 2}$$

in which $V_{beginning}$ and V_{end} represent respectively the speed of the fighter in m/sec at the beginning and end of zooming.

Thus, reducing speed by zooming creates the necessary conditions for successive fighter attacks. The plane in trail attacks at adjusted speeds, while the lead plane attacks with a speed reserve, at the same time protecting the plane, in trail from the bomber's fire during the former's entry into the firing position at close range.

Successive attacks by a pair result in a disruption of its formation. In order to reestablish it, the first fighter maneuvers for a repeat run on the target while the second fighter attacks; upon withdrawing from attack, the second fighter formates on the lead plane.

Let us note that attacks with adjusted speeds are employed in those cases when the enemy operates without cover or when his fighters are engaging other groups of aircraft.

In all other cases our fighters must attack the enemy with a speed reserve, and the more complex the air situation, the greater that reserve should be. If the hostile bombers have strong fighter cover, a considerable speed reserve permits striking at the main target, i.e., the bombers, while evading the attacks of the escort fighters. This is explained by the fact that the escort fighters' speed, as a rule, cannot exceed to any considerable extent that of the bombers. Consequently, a fighter attacking with considerable speed reserve can slip past the escort fighters which will be capable of attacking it only in the event it lags, and such attacks are hardly effective.

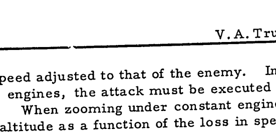


Fig. 4. Formation of a pair in order for the plane in trail to parry the enemy attack.

Another tactical procedure which can counteract the operations of the escort fighters is a suitable formation of a pair and a flight with due regard for the capabilities of the enemy escort fighters.

Aircraft performance characteristics deteriorate in the stratosphere; therefore the escort fighters are capable of attacking effectively only within a narrow sector of the rear hemisphere with an angle-off of 1/4 - 2/4 at a range not exceeding 500-600 m. In order to protect the lead plane, which is attacking the enemy bomber, from fighter escort fire, the plane in trail ought to be located behind the leader at a distance of 1000-1200 m. In this case, moving into the critical area, he will be able to parry the enemy's attack on the plane ahead (Fig. 4).

We must note that for a successive attack on the same target (gun-target distance equals 1200-1400 m), the distance between fighters should be 1000-1200 m. From this we see that a fighter formation designed for a successive attack at the same time allows the trailing aircraft to supply cover for the lead planes.

Thus, in stratospheric aerial combat, when dealing with a mixed enemy group, there is no reason for splitting one's forces in two: one force for destroying the bombers, and another for supporting the attack. It is better to direct all the fighters towards destroying the bombers. Escort fighter attacks will be repulsed by only those planes which encounter such a problem in the course of the engagement.

In order to repulse the escort fighters within the narrow sector of the rear hemisphere, the pilot in trail will not be obliged to change his heading appreciably. In stratospheric aerial combat, the second fighter, for the purpose of attacking the escort plane, moves in his direction without altering his overall flight heading. This will force the enemy to evade combat. It is more than likely that he will maneuver around towards the attacking fighter in order to force him to come out at a greater angle-off. In the end, not having any speed advantage, the enemy will fall behind and will not be able to assist in repelling the attack on the bomber.

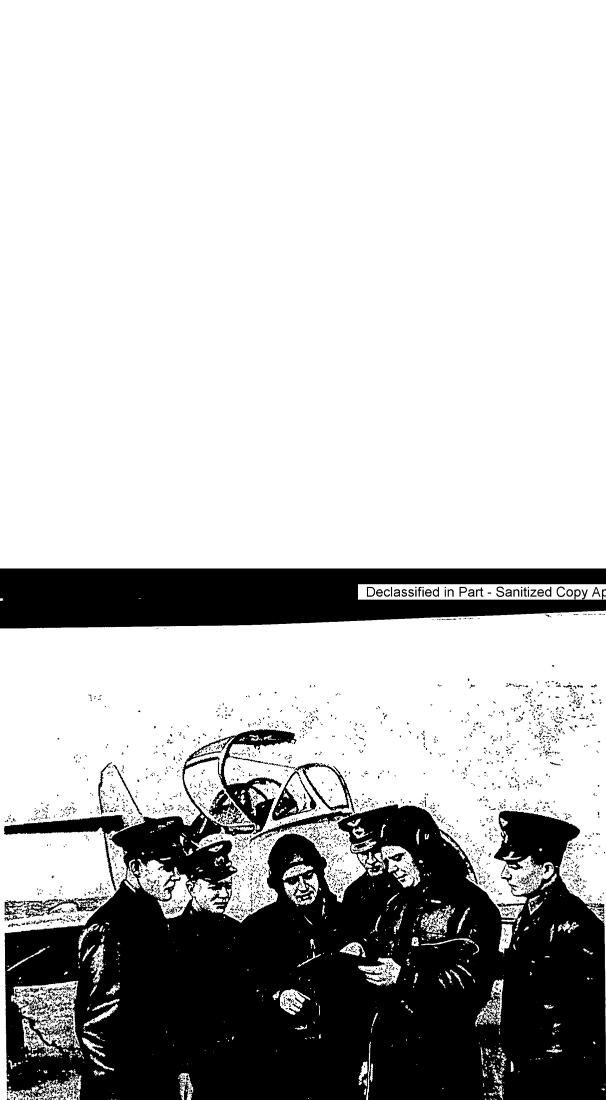
The pilots who are engaged in repelling the escort fighters need not pursue them for any length of time. Their primary mission is to force the enemy to decline the attack and to turn away.

In certain instances, when the escort planes are flying at close intervals with respect to the bomber's flight axis, it is advantageous to close in in such a way that they [the escort fighters] will be aligned with the bomber. Such a method of closing in will look like an attack on the escort fighter and will force him to engage in a defensive maneuver. This maneuver — in view of his speed disadvantage and reduced performance capabilities in the stratosphere — will hamper his ensuing actions against the fighter which is attacking the bomber.

However, even if after such a maneuver the escort fighters remain in their former position, it is imperative to attack and to force them to turn away. Otherwise, at the moment when the attacking fighter approaches the bomber, the escort fighters will be in a position advantageous for repelling his attack.

On the other hand, an attack on an escort fighter aligned with the bomber does not exclude the possibility of changing over into an immediate attack on the bomber.

Such are some of the fighter tactical maneuvers for stratospheric aerial combat. They will enable the fighters to carry out more effectively, under given conditions, their combat mission.



ОБУЧЕНИЕ и ВОСПИТАНИЕ

TRAINING AND EDUCATION

DEVELOPING COMBAT HABITS IN PILOTS

Guards Major General of the Air Force Yu. B. Rykachev

A basic factor in organizing and conducting the combat training of flying personnel in any branch of the Air Force must be the development of essential combat habits, particularly during air training exercises, in the pilots, navigators, aerial radio gunners, and all members of the crew.

Nevertheless certain branches and types of flight training are sometimes studied in an abstract manner, divorced from the ultimate aim: the training of a skilled, intrepid air fighter. Such a defect occurs frequently in an instance where, for example, flight training under adverse weather conditions is not combined with other very important elements of the mission — interception, aerial combat, etc., where aerial gunnery

or piloting in the zone are not correlated with aerial combat. Now, after all, it is well known to every commander that outstanding execution of aerobatics and advanced piloting is necessary for pilots, not as an end in itself, but as a means for utilizing all the potentialities and performance of an aircraft in aerial combat.

In some elements, the missions being carried out have a one-sided character at times — almost the entire allotted flying time is spent on perfecting isolated operations by the crew. There is no doubt that high-level training of individual crews is indispensable, but it is bad if at the same time attention to group training is relaxed. We sometimes evaluate the result of work which has been done in accordance with the number of pilots flying during weather minimum, and we do not always ask ourselves whether they can carry on combat above the clouds as part of a flight or a squadron. Or we count the number of bombings for each crew in a year, and we do not ask ourselves if these crews can operate in steady succession at night, and inflict an adequately massive blow

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M. L. Gallay

P. Ya. Gerbinskiy

S. D. Golovachev

in a given unit of time, or if they can operate in groups in the daytime under fighter cover.

One of the reasons for such an approach to the matter is, in my opinion, a not entirely apt evaluation of the work of the pilots. After all, the hours of flying time credited to a pilot and to a unit as a whole, the number of pilots trained for operations under adverse weather conditions, and the number of bombings, gunnery exercises and instances of firing, aerial combats — all these are still far from providing a complete picture of the work which has been performed. These data reflect more the quantitative aspect but are insufficient for an evaluation of the capacity of the element or unit to carry on organized group combat operations.

Leading Air Force commanders — P. I. Kokorev, for example — strive to organize the entire training in such a way that the young pilot is imbued from the first flights with combat qualities, efficiency, and a spirit for the offensive. From the first pattern flights and flights into the zone, habits of caution are inculcated in the young pilot. Daily and persistently the thought is impressed upon him that this is absolutely essential for any kind of combat sortie. Lack of sufficient caution may result in the enemy's attacking first or being first to occupy the more advantageous position in the air. And in order to emerge as victor from an aerial combat, one must himself display initiative.

Parallel to the development of habits of caution, the aspiration to participate in an active sweep is fostered. The young pilots are trained in such a way that they will be able in any situation to utilize all their advantages over the enemy swiftly and correctly, know how to occupy an advantageous position for an attack, to be first to attack, and to avoid being spotted to the very last moment.

That is possible only on condition that the flying personnel trains constantly and persistently and develops consistently the tactics and technique for an active sweep as well as the other elements which make up aerial combat. It is important for fighters,

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for example, to learn, when closing in, to make absolutely certain that they have an altitude advantage over the enemy in order to have a reserve of speed when attacking, to come in out of the sun, taking cover behind the clouds wherever possible.

The fighter must conduct a circular sweep constantly and strive always to be first to spot the enemy and make a surprise attack. At the same time even during the very course of the battle he must not cease observing the situation in the air but must continue the sweep and by skillful maneuvering attain an advantageous position for the attack. And he must be taught this during every flight. Frequently we see many contrails in the air, and we know very well that they manifestly reveal the whereabouts of aircraft. But it is not enough to observe and know this; the fighter and bomber must be required daily to avoid leaving such traces behind them in the air by maneuvering skillfully for this purpose in accordance with the altitude.

Of exceptional importance for every pilot are: discipline in the air, an exact and efficient execution of assigned orders, and the ability to maintain strictly one's position

in the combat formation of the group. And the commander must constantly inculcate all these qualities in his men, by manifesting strict exactingness, making flight assignments clearly, and checking in proper time on the execution of all his instructions.

We may be asked the following questions: Is the methodology correct, if the very first flights are saturated with tactical elements? After all, are not these flights by their very nature still very remote from aerial combat? We will answer: Yes, they actually are remote from aerial combat. But the elements of such combat are contained in them. Subsequently, while observing strict sequence in training, the commander will assign the pilots new, more complicated tasks. And, since they will already have the elementary combat habits, the pilots will perfect them and add to them.

Flying and tactical training are inseparable links in one chain, and it is completely natural that such problems must not be settled separately.

The logical culmination for classroom instruction in tactics is the combat training flight and preparation for it. A gap, an absence of close coordination between them makes the entire work one-sided and inferior. In order for this not to happen, every flight must be coordinated, insofar as possible, with tactical requirements. The tactical background for flights must always be concrete and correspond to the nature of the exercise being conducted.

The commander of an Air Force fighter unit, V. I. Borodachev, takes all this into account. It cannot be said that the entire combat training work in the elements under his charge is carried on faultlessly; but he does give special attention to imbuing the flying personnel with combat habits. Air Force commanders strive to concretize the tactical situation in which the scheduled flight will be conducted. Every day they impress upon their pilots the importance of being well acquainted with the enemy, his quantitative and qualitative composition, and with combat formations and the principles of tactical operations.

In the course of combat training, the tactical horizon of the flying personnel is constantly being broadened, and their ability to employ one method or another grows, depending on the existing conditions.

It is no less important for the pilot to know the situation on the ground thoroughly. Its elements are pin-pointed before flights. For example, the "front line" is associated with typical landmarks, instructions are issued for the operational organization of "defense" and the deployment of "enemy" troops in defense or in areas of concentration. On the basis of these data, the crews look for their targets or objectives on the terrain. In all cases, the situation on the ground is closely coordinated with that in the air.

The flying personnel of bomber aviation learn to take advantage of any situation which comes up by considering both the effect of AA artillery and guided missiles, as well as other factors.

Leading officers teach their men to carry out combat training missions at high speeds and altitudes, with limited time on the bombing run. They lay particular stress on the necessity for knowing how to hit the target on the very first run and to find well camouflaged objectives under adverse conditions, swiftly and without error.

In order for combat habits to be developed during each flight, the pilots must be taught to reach a swift decision in planning their aerial combat upon encountering the enemy. Upon spotting single aircraft or a group, the pilot must at once evaluate both the situation and the mutual location of aircraft, and decide what maneuver to apply in a given instance, in order to achieve victory in aerial combat.

In perfecting flight teamwork, one must not forget about combat formations. As is well known, they have various specific features, depending on the nature of the mission, the size of the group, etc. Thus, among fighters in an assault group or in an escort group, when directly escorting bomber aircraft, the combat formation en route is of one type, while during bomber operations in the target area it is somewhat different.

The pilots must know this, because the change of combat formation at various stages of the flight is not dictated by some sort of abstract circumstances, but by the necessity for better execution of the mission. When direct escort is being provided, the combat formation of fighters is a defensive one, but when support is being provided in the target area, their mission consists in preventing the enemy from attacking the escorted bombers. Here their combat formation is of an offensive nature. The enemy must be spotted while approaching the target, and his attacks must be forestalled and he himself destroyed.

During operations against ground targets on the battlefield or deep in the enemy defenses, there will be even more special features in the set-up of combat formations within the component groups.

The basis of combat fighter formation is the pair and the flight. They can function in various elements of a squadron's combat formation, while a squadron can function in the various elements of a unit's combat formation, and so on. It is precisely for this reason that all pilots, lead pairs, flights, and squadrons must have a clear knowledge of their missions and their position in various formations. But for this purpose, constant study and training are necessary. Leading Air Force commanders actually do proceed in this way: in every flight, their men work out various combat formations corresponding to the conditions of the exercise being carried out against a tactical background.

But in some units a different picture may be observed. There too teamwork is being developed, since, after all, it is provided for in the program. But some officers, in carrying out group sorties, strive above all to establish the status necessary for advancement to the next class rating. As a consequence, the groups fly, not in combat formations but in regular formation. For fighters whose combat formations differ markedly from regular formation, such a practice is nothing but a waste of alloted facilities and of the planned flight norms.

It also frequently happens that combat formations are set up without an analysis of, and consideration for, the special features of one's own aircraft and those of the enemy, and of the correlation of speed and other factors that influence the course of aerial combat. Recently, for example, the fighters commanded by M. I. Zotov, in organizing an escort, placed one group of aircraft at the head of the column of bombers and another at the tail of the column. The first group of fighters was intended for repelling attacks on head-on collision courses from the front hemisphere.

Such an arrangement was obviously made without basis. First of all it is most likely that an enemy will attack from the rear hemisphere at angle of no more than 45° to the axis of the aircraft under attack. But he may attack on collision courses as well. In both the former and the latter instances, the main task of the fighter escort is to forestall the enemy attack by attacking him at the moment he is preparing to strike at the bombers. If we take into consideration the correlation of speeds during frontal attacks by modern aircraft, then an encounter by our fighters with the enemy must take place

at a distance of several kilometers, at the extreme limit of visibility. That means that the position of the fighter escort at the head of the column of bombers is useless. They must be moved out in front.

In exactly the same way, the position at the tail of the column was an unhappy selection. The task of the fighters immediately escorting the bombers is to repel the enemy with fire before he himself manages to open fire on our bombers.

From what has been said above, we may reach several conclusions. The principal one is that in order to develop combat habits among the flying personnel, there is absolutely no need to conduct any sort of special flights. In all flights, including those made under adverse weather conditions, it is necessary to achieve faultless piloting technique, perfect mastery of the elements of combat application, and to train the pilot to analyze thoughtfully the technique and tactics of the enemy. In working out separate exercises in connection with the course, we must coordinate them with the development of combat habits. The team spirit of a pair and of a flight, combat formations under various conditions, aerial gunnery, and aerial combat — all must be mastered not in an abstract manner but in a concrete tactical environment. In this connection, by the way, the vulnerable positions of the enemy's aircraft are studied, as are also the most advantageous methods for attacking them, the fire area of one type of aircraft or another, the area of backwash, the distinguishing characteristics of configuration, etc.

In working out cooperation with the ground troops, one must at the same time learn "to read" the front line and the deployment of troops deep in enemy defense, and also to look for camouflaged objectives on the battlefield: artillery, tanks, mortar batteries, and concentrations of troops and equipment.

The commander must saturate all flights with elements of a sweep and of caution, and train the fighter pilots always to look for the enemy and down him with the first attack. In this way only will the pilot be imbued with a combat spirit, decisiveness, boldness, and readiness for active offensive operational methods.

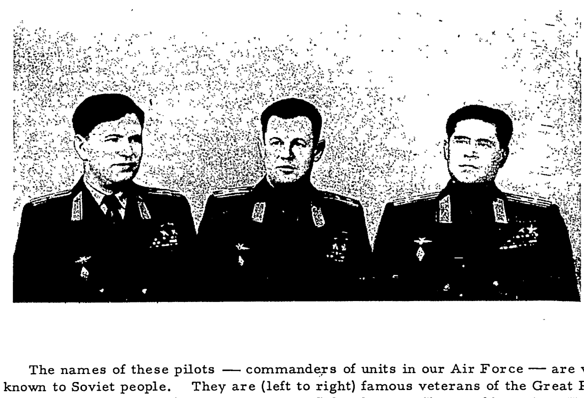
Many combat habits among the flying personnel are worked out during the process of ground training. In leading units, therefore, a great deal of attention is given to the correct formulation of that training, and to the equipment of classes with visual aids. In classes on tactics, for example, necessary materials for organizing and conducting aerial combat are available. Combat formations and methods and means of attack are depicted on charts and demonstrations are given of essentially different targets, the camouflage of these targets on the battlefield, and the distinctive features by which they are recognized.

It is expedient also to equip the classes with firing charts and posters which show how the target or aircraft looks in the sights at various ranges, at the commencement of sighting, at the commencement of opening fire, and at the moment of withdrawing from the attack. Such charts may be kept not only in the classrooms but also in places where the flying personnel reside permanently.

During the course of ground training, the pilots must constantly train at sighting from the cockpits at mockups of aircraft on airfields at actual ranges. And these mockups, it must be stated, have here and there become delapidated and are not being used. It is helpful to place three aircraft at various ranges: at the commencement of sighting, at the commencement of opening fire, and at the withdrawal from attack.

Constant improvement in organizing and conducting combat training and the execution of requirements necessary in combat — all these will undoubtedly enhance the combat efficiency of the flying personnel.

TWICE HEROES AND OUTSTANDING MEN IN TRAINING



The names of these pilots — commanders of units in our Air Force — are widely known to Soviet people. They are (left to right) famous veterans of the Great Patriotic War. Twice Heroes of the Soviet Union, Colonels N. M. Skomorokhov, A. N. Yefimov, and I. N. Stepanenko. In the combat score of each of them is a large number of downed enemy aircraft as well as of destroyed manpower and equipment. Skomorokhov's personal combat score is 46 enemy aircraft and Stepanenko's 33. Yefimov ground-attacked enemy columns dozens of times and inflicted great losses on the troops of the invaders.

The Motherland has highly evaluated the combat skill, bravery, and boldness of these pilot heroes.

After the end of the Great Patriotic War, they all graduated from the Military Academy. They were entrusted with the responsible work of mastering new jet equipment and training young flying personnel. The combat experience that they had acquired on the battlefields was very useful. With these veterans, young pilots studied the art of employing aircraft in combat, acquired habits of accurate firing, and mastered the art of flying under adverse weather conditions even at night. During the post-war years, Twice Heroes of the Soviet Union, Comrades Skomorokhov, Stepanenko, and Yefimov have trained many experts in aerial combat and sniper gunnery.

Now they are studying again. Modern military equipment places great demands upon the officers, especially if the officer heads a unit or a group. The Air Force commander must know a great deal and be able to do a great deal. Only on that condition will he be able to ensure the combat readiness of the flying personnel.

Twice Heroes of the Soviet Union Skomorokhov, Yefimov, and Stepanenko, serve as an example for other officers. They are top men in training, and they have only excellent ratings in all the subjects they are studying.

A MEETING OF THE COUNCIL OF THE MILITARY SCIENCE SOCIETY OF A UNIT

Since the very first months of its existence, the council of the Society where officer M. I. Dorfman is chairman, has worked out a detailed schedule and put into effect monthly meetings for considering urgent problems.

Thus, at a recent meeting, a report was heard from the secretary of the council, officer V. P. Kopylov, on the work of the Military Science Society. He disclosed the reasons for various shortcomings. It was explained that some members of the society were pursuing their research on their chosen topics slowly. This was taking place because many officers had set about military science work for the first time and they had encountered difficulties. The council decided to give them practical assistance, to explain where to begin the treatment of the topic, how to plan it, and to suggest the most expedient methods for research.

The council members found out that it is necessary to concretize the topics and to coordinate them more closely with the tasks being solved by the outfits. When topics are selected, of course, consideration must be given to the possibilities for treating them in the unit.

Then a scientific research paper, written by one of the officers, was discussed. It was on the employment of new means of combat by ground troops and on methods of reconnaissance. As a preliminary step he had consulted specialists with reference to this work. After becoming acquainted with it in detail, the members of the council made concrete comments. The positive aspects of the work as well as its shortcomings were noted. It was suggested that the author give more concrete form to the questions concerning reconnaissance.

Various opinions were expressed on the plan, style of exposition, and formulation of the work.

In accordance with the decision of the council, the members of the Military Science Society conduct briefings every week on new problems of Air Force equipment and on methods of it.

The council is also carrying on work for recruiting new members into the society. Thus, at the last meeting, officer D. A. Kharitonov was inducted into the society.

Regular meetings of the council of the society, with consideration being given to the most urgent problems, are undoubtedly contributing to the broad development of military science work and to raising the level of combat training in the outfits.

PHYSICAL TRAINING OF THE FLYING PERSONNEL

Thrice Hero of the Soviet Union, Maj. Gen. of the Air Force A. I. Pokryshkin

In the years of the Great Patriotic War, I was once an unwilling witness to a sad occurrence. Our young fighter pilot engaged an experienced Fascist ace in aerial combat. A combat with turning maneuvers ensued. Each of the pilots wanted to be the first to approach the other from the rear, decreasing for this purpose the radius of the turn and causing considerable acceleration forces. The pursuit circle, extended at first, grew tighter. Soon the crisis came. The enemy was the first to get on the tail of our fighter. The guns went into action. The young pilot was shot down.

On orders from the ground control post another of our fighters arrived at the scene of the dogfight. Almost the same performance was repeated — except that the outcome of the fight was different this time. Great confidence could be felt in the actions of our pilot. Nobody among those on the ground at the time had doubts that the enemy would receive his due. Of course the enemy by then was exhausted, but he made desperate efforts to come out victorious. He did not succeed. Hit by a well-aimed burst from the Soviet fighter, the enemy plane started to belch smoke and plunged to the ground.

We spent a long time analyzing the results of the aerial combat. Why was one of our pilots unable to withstand the enemy, while the other achieved victory? After all, they served in the same unit, flew aircraft of the same type, and hardly differed from each other in the level of flight training. And yet there was a difference between them: the second pilot was an excellent athlete. Physically fit, he could stand great acceleration forces and this gave him an advantage in aerial combat. While the first pilot (incidentally, he survived and soon returned to his unit) was indifferent to sports and was not concerned with conditioning his body.

From personal experience, I have learned how important it is for a pilot to engage in sports systematically. Good physical conditioning has helped in many an aerial combat, has made it possible to conquer a strong enemy in the air, to arrive in time to help one's comrades. The following combat episode comes to mind: My co-flyer Semenov and I were attacked by 5 ME-109's simultaneously. We spotted the enemy from afar as they began turning in our direction: three ME-109's flew at our altitude, two flew above. Having evaluated the situation, I decided to attack head-on and to get at the rear of the enemy with a subsequent combat turn. The attack was on. The distance between the aircraft shrinks rapidly. We fire, the enemy fires back, but without results.

Several seconds later our pair is charging through the formation of Messerschmitts. Jerking the stick back, I put the aircraft into vertical zoom, tumble it on the right wing. Now the Messerschmitts are again in front of me. At this moment the enemy fighters were below my plane and were turning to the left. I also complete

a turn to the left and begin to aim, when suddenly there appears on my right the tracks of bullets and projectiles. This means the enemy is also behind me. He is already firing at my aircraft. Having estimated from the tracks where the attacker is located, I jerk the stick back so abruptly that I gray out. But I do not lose consciousness. Glancing back, I see the attacking plane whiz by on the left.

In this case I was saved only by good training in sports and by being conditioned to acceleration forces; otherwise I could not have "broken away" with the plane so sharply and escaped from the fighter who was on top of me.

Again, just several minutes later, this quality aided me in helping my comrade out of a tight spot. Semenov tried to withdraw from combat by using a roll. An ME-109 was sneaking up on him from behind. I realized that my wingman needed help. With a half-roll I put the plane into a dive and soon found myself on the Messerschmitt's tail. I immediately open fire and see the fiery tracks bite into the fuse-

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N. S. Rybko

lage. The Messerschmitt zooms, I catch him in my sight again and set him on fire.

These are only isolated instances which show how important it is for a pilot to be physically strong and fit.

And have the requirements concerning physical fitness been reduced for the flying personnel in any measure? No, on the contrary, they have further increased. With the development of supersonic aircraft, physical conditioning of the pilot takes on as much importance as his technical and tactical training, as his flying skill.

In spite of this fact there are pilots who consider physical training a secondary matter. This is a serious mistake and must be eliminated. Marshal of the Soviet Union G. K. Zhukov has given a good evaluation of the importance of physical training and sports to the military man at the All-Army Conference of Outstanding Men:

"The nature of the commanding officer's job and that of the activity of the troops on the whole have become considerably more complicated due to altered conditions

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under which military action is conducted. The flabby, physically unfit officer, soldier or seaman will not be able to endure the great physical exertions of present-day combat. And even in peace times in our training work, the physically weak people cannot successfully cope with their service duties. I hope no insult will be taken, but unfortunately we have observed in recent years that some of our military men get corpulent prematurely and become sedentary, which is a great defect in any military man — not to speak of the fact that this has a detrimental influence on the man's health.

Good physical fitness is of tremendous importance to the pilot. It is known, for instance, that the combat activity of a fighter pilot involves exceptionally great acceleration forces on the body. In combat flight the pilot is also subject to considerable nervous tension. Flights under adverse weather conditions, combat at different altitudes and speeds— all require that the pilot have good physical stamina.

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K. K. Rykov

G. M. Shiyanov

But does this apply only to fighter pilots?

Considerable acceleration forces, partial oxygen starvation, motion sickness, fluctuations in temperature and pressure are experienced by the flying personnel of any present-day Air Force. This is the reason why it is necessary to develop and harden by all available methods the pilot's respiratory muscles, abdominal muscles, to exercise and to strengthen the nervous and cardio-vascular systems. In organizing the physical training of the flying personnel, tolerance of the body to great acceleration forces, strong muscles, speed of reaction, spatial orientation, and caution in the air and on the ground must be developed.

In fighter aircraft with powerful jet engines, a correctly established turning maneuver can be carried out at 7 G's and modern equipment permits even greater acceleration forces and turns in combat and in vertical maneuvers. This means that everything depends on whether the pilot is capable of withstanding such a stress.

If the pilot does not systematically engage in sports and does not exercise, his average tolerance to sustained acceleration forces will not exceed 4.0 - 4.5, and he will not be able to utilize fully the combat capabilities of his aircraft.

The same may be said of the navigator. The bomber navigator, as a rule, does not experience great acceleration forces in flight, but exceptional accuracy and precision in operating the bombing equipment is required of him. And if he is not sufficiently physically fit, he will not have the necessary accuracy in his work. And yet in a short period of time, during which the aircraft is on the bomb run, the navigator is in a situation which demands very precise and well-coordinated actions.

Physical endurance is also required of the maintenance personnel servicing modern aircraft. Jet equipment has considerably complicated the work of the maintenance personnel. One cannot discount the fact that flights at night and in adverse weather have become more frequent. Servicing planes in adverse weather or at night is considerably more difficult. The body must be physically fit.

Thus all flyers must be physically well conditioned and, above all, have a good overall physical development. In addition, soldiers of different aviation specialties must have a clear idea of which type of physical training and which type of sport best develop their professional qualities.

For instance, special exercises on revolving swings, the gymnastic wheel, the horizontal bar, parallel bars, and other apparatus increases tolerance to acceleration forces. Hence they are very important for the pilot. Volleyball, basketball, tennis, or fencing develops the habit of precise, well-coordinated movements.

In order that physical training and sports help the pilot develop the required specialized qualities most efficiently, it is undoubtedly necessary to have at least an elementary understanding of those physiological phenomena which take place in the body during flight. First of all, let us note that acceleration and acceleration forces produce changes in blood circulation. For instance, at the moment of pulling out of a dive, the blood drains from the upper part of the body. This can cause the pilot to gray out. If the stresses are reversed, conversely, blood rushes into the head. And if the pilot is not fit enough this may cause headaches and changes in the conjunctiva of the eyelid and the eyeball.

During training flights in jet aircraft we have repeatedly observed that pilots who underestimate the importance of physical fitness are more likely to suffer from these phenomena. Sometimes they could not even tolerate average stresses. Thus, once we were practicing formation flying, and vigorous maneuvers were being executed (diving, combat turns, zooming). I felt well during the exercises. But some of the pilots in trail experienced grayout; they lost sight of the leading plane and, after two or three maneuvers, dropped out of formation. All of them were pilots who did not much engage in sports.

The vestibular apparatus plays an important role in flight. With excessive or prolonged stimulation — for instance in doing certain advanced maneuvers, or in turbulence — some pilots experience fatigue, drowsiness, circulation is affected, the pulse rate increases.

Specially selected physical exercises increase the reaction stability of the vestibular apparatus under the action of acceleration forces. But it must be remembered that after a lapse in training, the acquired tolerance of the circulatory and vestibular systems drops considerably and the endurance of the body is decreased. Training of the organs of equilibrium, as well as of those of the circulatory system, must be carried out systematically and must be combined with flight work.

Physical exercises also promote the tolerance of the body to lack of oxygen, which is of great importance in high altitude flying. It is only necessary to select exercises which subject the pilot to conditions of oxygen starvation. Such exercises are fast running, ski runs, obstacle courses, etc.

Air Force commanding officers must know by what means the endurance of the flying personnel is increased. It is only necessary to remember that the means of increasing man's overall endurance are physical exercises connected with prolonged use of large groups of muscles (skiing, athletic games, cross-country races, etc.)

Good development of muscles is also achieved by calisthenics, weight lifting, wrestling, and other exercises. The strength of the abdominal muscles — essential to the pilot in withstanding acceleration forces — can be developed by working on parallel bars, the horizontal bar, stall-bars and stool, as well as by free calisthenics.

Rapid walking, running, skiing, develop leg muscles. The pilot whose legs and abdominal muscles are well developed is better able to withstand the mechanical shifting of the blood from the head to the legs and vice versa.

Speed of reaction to unexpected changes in a situation plays an important role in flight activity. Speed of reaction is developed in the course of systematic training, and through various sport competitions. Lightning-fast reactions are possessed only by people who box, fence or play athletic games, for example.

Thus we see that overall physical development as well as purposefully directed training, related to the character of flight work, are equally important to the flying personnel. But the maximum benefit from any physical exercise can be derived only on condition that it be well organized. It is necessary that the pilots come to like body building and sports, and understand their full importance for maintaining health as well as for the improvement of their combat readiness. These exercises and sports will become essential for them.

Sometimes it happens that the pilot attends such exercises unwillingly. This happens in those outfits where the physical instructors approach the training of the flying personnel without regard for specialization and the individual qualities of the officers. But is is extremely important to take these facts into account. The age, the general physical development, the nature of service duties — all must be taken into account.

Physical training among the flying personnel is organized by the commanding officer. On how demanding and skillfull he is depends the quality of the training. It is the duty of the Komsomol organizations to assist the commanding officers and chiefs in organizing physical training and, especially, mass sport activities. Communists, and even to a greater extent the Komsomol members, must spearhead mass sport activities.

Progressive Air Force commanding officers are striving to have more top-notch athletes in their units and outfits.

In order that physical training be conducted on a high level in the units of the Air Force, it is necessary to develop a core of athletes in the outfits who will function as instructor-leaders. This is a very important task, since physical training must be conducted with the officer's type of duty, his age and conditions of health in mind. If the outfit does not have a sufficient number of instructors capable of setting up the training while taking account of the characteristics of physical fitness of a given group, then we will not obtain the desired results. This is why the commanding officers must see to it without delay that qualified leaders be trained in the outfits and units for every group of officers. Obviously, it will be profitable to have periodic conferences of the instructor-leaders. It is also necessary to provide good sport facilities in the units.

At present the Air Force needs people possessing a high degree of physical fitness, which can only be achieved through systematic exercises in body building and sports. It is a matter of honor for the commanding officers to make body building and sports a favorite occupation of every soldier.

LONGITUDINAL CONTROL OF SUPERSONIC AIRCRAFT

Hero of the Soviet Union, Test Pilot First Class
Engineer Col. G. A. Sedov

At subsonic flight speeds, the present-day supersonic fighter plane[1] differs mainly from aircraft of the forties in having greater angles of attack. In the change-over from straight wings to sweptback wings and along with the increase in sweep-back angle χ, the curve slope of the wing's lift coefficient c_l along the angle of attack α becomes less acute (Fig. 1), and the critical angles of attack α_{crit}, corresponding to the maximal value of c_l and to the wing stall, increase. In present-day fighters with considerable wing sweepback they go up to 18 - 20°.

G. A. Sedov

In this connection there is a marked increase in the angles of attack at which the aircraft may be controlled safely in landing and take-off. Gliding prior to landing also takes place at a markedly greater angle of attack. At all these increased angles of attack, the aircraft maintains good stability, and the pilot is neither threatened by wing burbling nor by any other unpleasant effects. By the position of the cowling at lift-off and touch-down and by the rate of speed during the glide, the pilot judges whether or not he is correctly utilizing the aircraft's capabilities. Reducing the angles of attack when changing over from subsonic to supersonic aircraft may increase lift-off and landing speeds as well as take-off and landing distances.

In carrying out a maneuver in present-day fighters, the angle of attack must be altered considerably more than was necessary in the case of aircraft of the recent past. Fig. 1 shows that, if straight and sweptback winged aircraft performed horizontal flight with exactly the same lift coefficient value, $c_{l\ hor.\ flight}$, then, while executing a maneuver with the same acceleration forces, the angles of attack were increased up to $c_{l\ man}$, the aircraft with a wing sweep-back χ_3 must alter its angle of attack by a

1 Although this article will deal with flying fighter aircraft, many of the situations may be applied also to flying supersonic bombers.

considerably greater increment $\Delta\alpha_3$ than in the case of a straight-winged aircraft ($\Delta\alpha_1$). Increase in necessary "breakaway" of the aircraft is hardly noticeable when flying at high indicated airspeeds; however, at low and medium speeds it is quite perceptible. The danger of going into a spin in present-day supersonic fighters is negligible. In the first place, when the angle of attack is greatly increased, long before α_{crit} is reached, a warning burble flutter appears in the aircraft (in Fig. 1 its inception is shown by a point), the intensity of which increases with further increase in the angle of attack. In the second place, even if the pilot, disregarding the warning flutter, continues to increase the angle of attack, reaching α_{crit}, even then burbling diffuses evenly and any uncontrolled breaking of the aircraft into a spin is improbable.

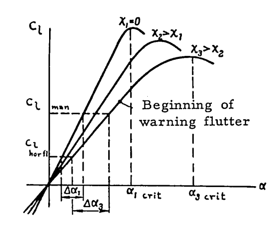


Fig. 1. Change in curve slope of wing's lift coefficient

If the pilot has any reason to fear breaking into a spin (very strong burble flutter, tossing of the aircraft from side to side), he must push the control stick somewhat forward, and then the aircraft will respond by assuming lesser angles of attack. This means that flying with increased angles of attack is sufficiently safe, and they can be used at low and medium instrument speeds in the subsonic regime in all cases when it is necessary to maximize the trajectory curve: in high-speed maneuvers, in executing low-speed rolls, if it is necessary to lose a minimum of altitude, etc. Angles of attack must be exploited right up to the onset of the warning flutter, while those pilots who have fully mastered an aircraft of a given type must continue right up to the maximum angles of attack. This piloting technique is of particular advantage in reducing the roll radius at high altitudes. Failure to use large angles of attack results in a maneuver with large radii — a "spread" maneuver.

Thus, the main distinguishing characteristic of longitudinal control of present-day supersonic fighters flying at subsonic speeds involves the necessity of controlling the aircraft at takeoff and landing, and during a maneuver with increased angles of attack.

Let us proceed to examine the peculiar features of longitudinal control at sonic and supersonic speeds.

As is well known, with certain assumptions, that point where increased aircraft lift is applied when the angle of attack is altered is called the aircraft's aerodynamic center.

If an aircraft is in straight and level flight, its lift Y is equal to the weight G and is applied at the center of gravity (Fig. 2). In this case, the sum of all the longitudinal moments equals zero.

In order to have the aircraft fly a curve with an acceleration force of, for instance, 2, the angle of attack must be increased to such

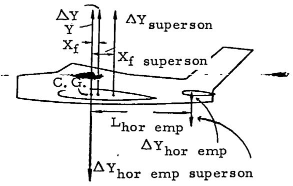


Fig. 2. Longitudinal effectiveness of control surfaces.

a degree that the lift Y = G will be increased by ΔY, also equal to G, since the longitudinal acceleration n_y is equal to the ratio of the aircraft's lift to weight. This lift increment will be applied at the aircraft's aerodynamic center. In any longitudinal stable aircraft, in the case of increased angle of attack and constant elevator or stabilizer position, the emergent lift increment ΔY will tend to restore the aircraft's original angle of attack, i. e., the aerodynamic center will be located aft of the center of gravity. Let us designate the distance from the aerodynamic center to the aircraft's center of gravity by x_F (Fig. 2). In order to maintain the aircraft at an angle of attack which corresponds to the acceleration force $n_y = 2$, the control stick must be pulled back, which will result in the application of an additional downward force, $\Delta Y_{\text{hor. emp.}}$, to the horizontal empennage. The distance from the center of gravity to the force vector $\Delta Y_{\text{hor. emp.}}$ we will designate by $L_{\text{hor. emp.}}$ The condition of balanced moments resulting from additional forces at the new angle of attack will be:

$$\Delta Y \cdot x_F = \Delta Y_{\text{hor. emp.}} \quad L_{\text{hor. emp.}},$$

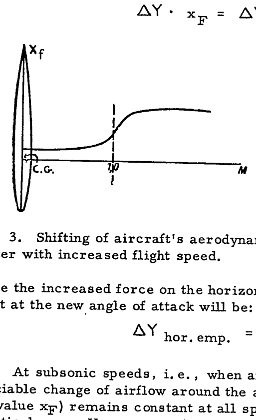


Fig. 3. Shifting of aircraft's aerodynamic center with increased flight speed.

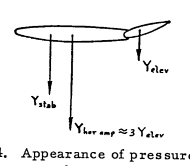


Fig. 4. Appearance of pressure difference on the upper and lower profile surfaces at subsonic flight speed.

while the increased force on the horizontal empennage necessary for holding the aircraft at the new angle of attack will be:

$$\Delta Y_{\text{hor. emp.}} = \Delta Y \frac{x_F}{L_{\text{hor. emp.}}}$$

At subsonic speeds, i. e., when any change in speed does not result in any appreciable change of airflow around the aircraft, the position of its aerodynamic center (or value x_F) remains constant at all speeds and at all angles of attack which are of practical use. However, at increased speed the aircraft's subsonic and supersonic aerodynamic center shifts radically aft, so that at supersonic speeds x_F is 3 - 5 times greater than at subsonic speeds (Fig. 3). This in fact means that the lift increment with increased angle of attack at high supersonic speed, $\Delta Y_{\text{supersonic}}$, will be applied 3 - 5 times further from the center of gravity than at a subsonic speed.

Let us examine aircraft flight at an indicated airspeed of, say, 800 km/hr, at two different altitudes: in one case at an altitude of 1000 m, i. e., in a subsonic regime with M $\approx$ 0. 7, and in the other case at an altitude of 12, 000 m, i. e., in a supersonic

regime with M $\approx$ 1. 3. In order to achieve the same vertical acceleration force n_y on the horizontal empennage for our example, it is necessary, at supersonic speed, to apply a force $\Delta Y_{\text{hor. emp.}}$ 3 - 5 times greater than in the case of subsonic speed.

If we were to compare the forces applied to the horizontal empennage with equal deflection angles of the elevator and at equal indicated airspeeds, then at supersonic speed this force will be considerably smaller than at subsonic speed. With deflection of the elevator in subsonic flight, a difference in pressures on the upper and lower profile surfaces appears, not only on the elevator itself, but also on the stabilizer (Fig. 4).

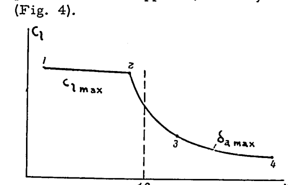


Fig. 5. Available lift coefficients in a present-day supersonic plane.

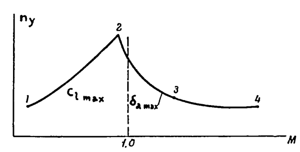


Fig. 6. The curve plotted on the basis of the available acceleration forces for a certain altitude.

In addition to force Y_{elev} applied to the elevator, there appears on the stabilizer force Y_{stab}, approximately twice as great as Y_{elev}. On the other hand, at supersonic speed, when elevator deflection does not result in any pressure redistribution on the stabilizer, the resultant force applied to the horizontal empennage will, in effect, be the force applied to the elevator; that is, it will be approximately 3 times smaller than the force applied to the horizontal empennage at subsonic speed.

Consequently, in order to maneuver with the same acceleration forces at equal instrument speeds in a supersonic regime, it is necessary to deflect the elevator 9-15 times more than in a subsonic regime. In other words, in flight at supersonic speeds the pilot runs into a considerable drop in effective elevator control. In the course of flying, this is evidenced by the fact that, at high supersonic speeds — particularly at high altitudes — the aircraft responds sluggishly to elevator deflection; over a wide range of Mach numbers, the pilot, for a more forceful maneuver, must pull the stick all the way back to himself.

How do the available lift coefficient values for a present-day supersonic fighter with elevator and fixed stabilizer appear? On the segment 1-2 (Fig. 5) the available values of c_l are determined by the maximal value of $c_{l\,max}$; when the angle of attack is further increased, wing stall occurs. On the segment 1-2 the pilot can bring the aircraft up to a stall with an incompletely positioned stick. At point 2 the stall will correspond to the completely positioned stick. On segment 2-3-4 are shown the values of c_l, less than $c_{l\,max}$. They correspond to the fully positioned stick $\delta_{a\,max}$. In a wide range of Mach numbers, due to the slight effectiveness of the elevator, it is impossible to put the aircraft into angles of attack corresponding to the onset of the warning flutter.

If this curve (Fig. 5) were replotted on the basis of the available acceleration forces n_y for any given altitude, it would appear as shown in Fig. 6.

Because of the insufficient effectiveness of elevators at supersonic speeds, the aircraft cannot assume angles of attack bordering on stalling angles; consequently, so long as the speed does not drop to the sonic level, breaking into a spin is impossible even with a fully positioned stick. Below Mach 1 breaking into a spin is possible at any point. If during a maneuver the speed varies slightly, the aircraft maintains the planned acceleration force with a greater degree of stability at supersonic speeds than at subsonic. But with intensive maneuvering the speed, as a rule, dissipates quite rapidly, and when approaching Mach 1, due to the forward shifting of the aerodynamic center as well as the reestablishment of elevator effectiveness (transition from point 3 to point 2 in Figures 5 and 6), the aircraft tends to increase its angle of attack and acceleration force; the aircraft "picks up", as pilots say, greater acceleration force. The "pick up" process is usually quite slow and the pilot has time enough to counteract it by smoothly pushing the stick forward into a neutral position. However, under the most unfavorable set of conditions (braking at supersonic speed, with a fully positioned stick, with full power-off and speed brakes set, in a climb, and with stern heaviness) "pick up" may be quite sudden, which will necessitate quick reaction on the part of the pilot.

Since the elevator, even when fully deflected, at supersonic speeds does not permit full exploitation of the wing lift characteristics, it has been superseded by a stabilizer adjustable in flight [floating tail]. The adjustable stabilizer is much more effective than the elevator and permits more vigorous maneuvers at supersonic speeds. The necessarily wide control-surface deflections and the increased hinge moment at supersonic speeds have made it impossible to control present-day high-speed aircraft manually (without additional devices). At first the pilot's muscle power was assisted by reversible power control systems; then they were superseded by irreversible systems — mainly hydraulic boosters. Essentially, the term "booster" is applicable only to a reversible control system, when an hydraulic amplifier takes only part of the hinge moment, since the basic meaning of the English word "booster" is "helper". On the other hand, when the hydraulic amplifier takes on the total hinge moment of the control surface, i. e., when the pilot, by moving the control stick, shifts the slide valve by means of connecting rods, and the hydraulic amplifier deflects the control surface, while the pressure from the control surface is not transmitted back to the stick, then the system may be more correctly called a simple irreversible power system and not a booster system. But since the appellation of irreversible booster systems has already been firmly established, we too shall refer to it thus in this article.

In recent years irreversible booster systems have completely predominated in high-speed aircraft. Since the forces from the control surfaces do not act on the stick when irreversible systems are used, and since the pilot cannot pilot the aircraft without any forces at the stick, its loading has been accomplished artificially. The simplest loading system involves the use of a spring mechanism whereby the force at the stick varies only depending on the amount of the stick's deflection. This fully enables the pilot to "feel" the aircraft by the forces acting on the stick in all regimes. However, this introduces a number of special features into piloting. At subsonic speeds in planes with manual controls, the stick "took on weight" as speed increased.

As a gauge of ease of control, it is customary to use the variation of the force at the stick, Δ Pa, necessary for altering the acceleration force Δn_y by one, i. e.,

$$\frac{\Delta P_a}{\Delta n_y}$$

(Fig. 7). This characteristic is usually called the acceleration force gradient. On aircraft with irreversible boosters and with the simplest system of stick loading (1), when $M < 1$, ease of control varies with the speed in accordance with a law which is contrary to the "natural" one, i. e., with increase in speed the stick "loses weight". Therefore in initial flights it is difficult to determine the speed of flight by the forces at the stick and it is necessary to refer to an instrument more frequently than is the usual practice. However, an average pilot, after only 5-6 flights, will be able to judge the speed of flight by the varying forces at the stick just as well as he would with manual control (2).

Fig. 7. Graph of forces in relation to G-load.

It should be kept in mind that, in contrast to manual control, in the case of irreversible booster control, at the moment of approaching top center of a loop or halfloop, the rated pull at the stick does not decrease but rather increases, causing the pilot to feel at first as if he were overapplying the stick. Therefore some pilots ease the stick and a stall occurs on the loop. One must remember that, during the pullup for a vertical maneuver, an ever-increasing pull must be exerted on the stick. Until the pilot becomes accustomed to the nature of the rated forces he may judge his piloting on the loop by the position of the stick; at the beginning of the loop it is positioned in such a way as to produce the acceleration force prescribed in the operating instructions for a given type of aircraft; thereafter the stick's position remains, on the whole, unaltered until top center of the loop is reached. The pilot has greater difficulty in controlling the position of the stick than the pressure on it. Therefore, as soon as the pilot becomes accustomed to evaluating the rated forces, he must change over to control in accordance with them.

In aircraft with more advanced systems of loading, where the forces on the stick depend not only on its deflection, but are further corrected according to impact pressure, altitude, or Mach number, the forces on the stick no longer vary unnaturally with speed. In such aircraft the pilot need not relearn in order to judge correctly the flight regime.

The effort to increase the effectiveness of the elevator at supersonic speeds results in the fact that, when using the simplest irreversible booster system, the control surface becomes overeffective at high indicated airspeeds of $M < 1$, i. e., at low altitudes, while the stick eases excessively as far as longitudinal control is concerned. A comparatively slight change in force at the stick corresponds to a significant change in acceleration force. When the controls are too easy, it is difficult to regulate the forces applied to the stick and it becomes impossible to control the aircraft. In trying to counteract the acceleration force in one direction, the pilot may unwittingly submit the aircraft to an excessive acceleration in another direction. In addition, since the frequency of longitudinal oscillations in certain aircraft at given speeds is comparable to the maximal frequency of stick positioning by the pilot (when counteracting the oscillations), the pilot, in his effort to eliminate the oscillations and while positioning the stick in accord with the oscillations, can actually increase them, i. e., create a regime of longitudinal "rocking" of the aircraft with progressively increasing positive and negative acceleration forces.

In all operational aircraft the control characteristics are so selected as to keep down the over-effectiveness of the control surfaces, the ease of control, and the tendency towards "rocking". However, in case of failure or incorrect operation of the control system, the plane may tend to change over to this very dangerous regime. We are not going to analyze the individual control systems and their failures, but will limit ourselves only to general suggestions. Independently of the aircraft's control surface (elevator or adjustable stabilizer), as well as of the irreversible booster system (the simplest or one with correction of forces and gear ratio according to the impact pressure and Mach numbers or altitudes), the following points must be kept in mind. Stiffening of the longitudinal control — increase in loading mechanism forces, reduction of transmission ratio between the stick and the control surface — in comparison with the norm for a given speed is not dangerous, since it may result in only limiting the aircraft's maneuver, a more rapid onset of pilot fatigue in flying, and a certain complication in landing procedure. On the other hand, considerable easing of longitudinal control, in comparison with the norm for a given speed, greatly complicates piloting; moreover at high subsonic speeds and low altitudes it makes aircraft control impossible and leads to progressive longitudinal "rocking".

If for any reason the aircraft goes into a rocking regime, it is not necessary to counteract each individual oscillation with a stick movement, since this will only worsen the situation. It is necessary to hold the stick in a position slightly behind neutral. Thus the aircraft will lose speed and will quickly cease oscillating. Should the pilot discover that, at high speed and low altitude, control has eased excessively, but that the plane is nevertheless controllable, he must smoothly enter it into a climb and dissipate speed until a safe rate is reached — but under no circumstances should he set the speed brakes. In this connection any abrupt throttling down or jerking the stick, i. e., any manipulations which might suddenly disrupt the aircraft's trim, are out of the question. In supersonic flight regimes longitudinal stability increases so much that even at high indicated speeds easing the controls does not produce any undesirable results.

In high-speed aircraft manual control of the control surface is on the wane. Irreversible booster systems have more than one alternate. Emergency control systems are made as irreversible power systems: hydraulic or electric. However, even at present there are still some high-speed aircraft with elevators for which there is emergency manual control. Since this is very difficult for the pilot, we will dwell on it. In checking the longitudinal trim of the aircraft with the booster system off, the elevator tab is set in such a position that, should the boosters fail, in order to maintain straight and level flight, it will be necessary to apply pressure to the stick, i. e., so that the aircraft will tend to pitch. Slight pulls are in order only at very low indicated speeds. The trim tab position which allows such pulls is called the trim position. It is usually shown

in the aircraft's data sheet and on the trim tab itself. A typical curve of forces on the stick when there is elevator booster failure is shown in Fig. 8.

The forces on the stick resulting from the hinge moment at low speeds are usually insignificant. At medium speeds at M=0.75 - 0.85 (point 1 in Fig. 8) the pressure at high altitudes is also slight. At low altitudes it goes up to 10 - 20 kg, while in some aircraft it reaches 25 - 30 kg. At supersonic speeds (segment 2-3-4 in Fig. 8) the pressure on the stick can be measured in tens, and can even exceed hundreds, of kilograms. How will the aircraft behave at various speeds when the booster fails?

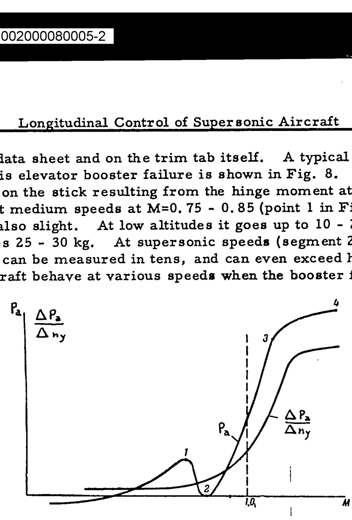


Fig. 8. Curve of forces at an aircraft's stick which arise when the elevator booster fails.

Over the entire range of subsonic speeds at any altitude with the trim tab in trim position the pilot will be able to cope with the forces which appear at the stick, and to fly the aircraft in a straight path and to make turns. If the booster fails during the piloting, the pilot will be able to bring the aircraft out of the maneuver into straight and level flight.

If the booster fails at supersonic speed, the pilot may not be able to cope with the extreme emergent pressure on the stick. In order to evaluate the behavior of the plane in such a situation, let us see how the force gradient on the stick according to the Mach number varies relative to the acceleration force $\frac{\Delta P_a}{\Delta n_y}$ (Fig. 8). At subsonic speeds this gradient lies within the limits of 2 - 4 kg per unit of acceleration force. As Mach-1 is approached, the gradient begins a sharp increase and, at supersonic speeds, it is measured in tens of kilograms per unit of acceleration force. If the pilot does not counteract the forces at the stick, but simply lets it go, the aircraft will enter curvilinear flight with an acceleration force. The increased acceleration force will equal the force at the stick P_a necessary to hold the aircraft in horizontal flight divided by the force gradient relative to the acceleration force $\frac{\Delta P_a}{\Delta n_y}$ for a given Mach number. At supersonic speeds, not only does the force at the stick P_a increase, but also the force gradient $\frac{\Delta P_a}{\Delta n_y}$. The ratio of these values in the case of operational aircraft is such that the increment of acceleration force, when the booster fails and the stick is free, reaches 3 - 4 G's at medium altitudes, while at high altitudes it does not exceed 1 - 2 G's. If, on the other hand, the pilot prevents pitching, then, even though he may not succeed in maintaining the aircraft in straight and level flight, still he will considerably reduce the acceleration force with which the plane starts pitching. Thus, in flight at supersonic speed, when the booster fails, the pilot may not be able to prevent the plane from pitching.

If this happens, the engine rpm should be cut down to idling and the aircraft should be allowed to pitch. It will quickly drop down to subsonic speed, after which the pilot will again be able to cope with the forces at the stick. A change-over to pitching with slight acceleration force, whenever the boosters fail at supersonic speeds, is characteristic of all high-speed aircraft equipped with elevators. Such aircraft behavior, whenever the elevator booster fails, insures a safe transition to subsonic speed, i.e., to regimes in which the pilot can control the plane even without a booster.

When flying with a booster which is not operating or which has failed, the pilot, by moving the stick, overcomes not only the hinge moments at the control surfaces, but even the considerable friction in the booster. This complicates piloting appreciably, particularly at low altitudes, since the friction interferes with one's feeling the aircraft speed by the forces at the stick. In order to pilot the aircraft correctly, the flight regime must be frequently checked by reference to the speed indicator — particularly on the landing approach.

* * *

How should the elevator trim tab be used in flight? We assert that the pilot will be able to cope with the forces at the stick when the booster fails at subsonic speed, provided the trim tab has been set in trim position. But if the trim tab is in some random position — the most undesirable being an extreme position — then at high indicated airspeeds the forces at the stick may be such that the pilot will be unable to cope with them. Therefore, prior to every flight, it is necessary to make sure that the trim tab is in trim position. This is particularly important, moreover, because with irreversible booster systems the pilot, flying with his booster operating, does not realize, by the forces at the stick, that the trim tab is incorrectly positioned.

As a rule, electrical circuits do not allow for using the trim tab when the booster systems are working; but there may be some instances where there is no such blocking. If, when the irreversible control system for any one of the control surfaces is working, the pilot uses the trim tab in flight, he commits a most senseless act and thereby demonstrates a blatant ignorance of aviation equipment.

The trim tab is used when flying without a booster; however, one must know how to use it. Let us examine a somewhat simplified diagram of how a trim tab operates. Let us assume that the aircraft has been trimmed in straight and level flight by using the trim tab which subsequently was deflected to a certain angle, say, for pitching. If no force is applied to the stick, then the deflection of the trim tab will deflect the elevator to a new position of equilibrium; this, in turn, will result in a definite change of the aircraft's angle of attack and acceleration force. At subsonic speed, when the trim tab is deflected downwards, the aerodynamic force will be applied, not only to the trim tab P_τ (Fig. 9), but also to the control surface itself P_τ', due to the redistribution of pressure on the aft part of the control surface. The moments of these forces, relative to the control surface's axis of rotation, will balance the moment of force P_{elev}, applied to the elevator and deflecting it downwards. At supersonic speed, deflection of the trim

tab will not cause any redistribution of pressure on the trailing edge of the elevator and there will be no force P_τ'. On the other hand, the force P_{elev} will be further removed from the axis of rotation than it is at subsonic speed. Therefore, when the trim tab's angles of deflection are equal, at subsonic speed the equilibrium of the elevator-trim tab system occurs with a greater elevator deflection than at supersonic speed.

We have come to the conclusion that, in order to carry out a maneuver with equal acceleration forces in a supersonic regime, it will be necessary to deflect the elevator by an amount 9 - 15 times greater than is necessary in subsonic regime. If we were now to evaluate the effectiveness of the trim tab on the basis of acceleration force change caused by trim-tab deflection, then we will note that the effectiveness of the elevator trim tab in supersonic flight regime is decimally less than in subsonic regime.

Let us take two examples of the incorrect use of trim tabs. Let us assume that, in supersonic regime with straight and level flight, the booster has failed. In this case strong pressure occurs at the stick which the pilot is not able to overcome. The plane goes smoothly into pitching; the pilot wants to reduce the pressure at the stick and moves the trim tab into diving position. The pilot can even deflect the trim tab all the way and still he will not feel any perceptible decrease in pressure at the stick or any lessening of the acceleration force, which is slight to begin with. However, as soon as speed drops to subsonic, the trim tab will become effective and will precipitate the aircraft into a dive.

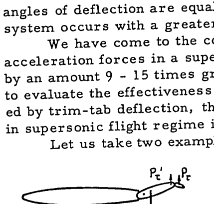


Fig. 9. Diagram of trim-tab deflection at subsonic and supersonic speeds.

Let us suppose now that the booster fails in supersonic regime, but during a dive. Strong pressure also appears at the stick and the plane begins to recover from the dive. If the pilot has to bring it into horizontal flight with an acceleration force greater than the one which corresponds to zero force on the stick, he can achieve this by exerting a heavy pull on the stick. But if he wants an assist from the trim tab, then, even if he deflects it all the way to pitching, he will not notice any help. But as soon as speed drops to subsonic, the trim tab will recover its effectiveness anew and will throw the plane into pitching. If this occurs at medium altitudes, the pilot may not have sufficient strength to prevent the plane from picking up great acceleration force and from breaking into a spin.

This must lead to the conclusion that the use of the trim tab at supersonic speed is not only futile, but even hazardous. And since trim-tab effectiveness begins falling off some time before the aircraft attains sonic speed, the trim tab should not be used at Mach numbers exceeding 0.85 - 0.9.

Thus, in the event that the elevator booster fails in supersonic regime even when $M > 0.85 - 0.9$, speed must be reduced with the trim tab in trim position, while when $M < 0.85 - 0.9$ it is necessary to resort to the use of the trim tab to reduce pressure at the stick.

BOMBING WITH THE USE OF AN AUXILIARY AIMING POINT

Military Navigator First Class, Col. M. N. Galimov

Bombing with the use of an auxiliary aiming point expands the tactical capabilities of the radar bombsight in operation against targets which do not offer radar contrast.

Various structures and natural reference points can be used as auxiliary aiming points (large railroad bridges and industrial plants, characteristic river bends, seashore-line configurations, as well as man-made radar points — such as corner reflectors).

We will examine only two methods of bombing by using an auxiliary aiming point.

In essence, the first of these involves providing for a planned bomb short relative to the auxiliary aiming point, depending upon the value of aiming off S_{ao}. In this case, flying proceeds along the line target — VTP [auxiliary aiming point].

The planned short — relative to the VTP — is achieved by introducing a fictitious number of rotations of the friction disc (n_f) into the synchronous bombsight. These rotations make it possible to set an aiming angle at which the bomb is released with an intended short of a planned amount.

Their number may be calculated according to the formula:

$$n_f = \frac{5300}{T + \frac{S_{ao}}{W}} \quad (1) \quad \text{or} \quad n_f = \frac{5300}{T_f}, \quad (2)$$

where T equals the bomb's time of fall for the planned flight conditions;
S_{ao} equals the distance from the VTP to the target;
W equals actual aircraft speed on the combat course;
T_f equals the bomb's fictitious time of fall, which equals $T + \frac{S_{ao}}{W}$.

A diagram for range aiming by the indicated bombing method is given in Fig. 1. From an analysis of the aiming diagram and formula, it is apparent that the bomb's fictitious time of fall changes in proportion to the actual speed; this means that the value n_f will also be variable. Therefore, in order to release the bomb at the proper range, before takeoff the navigator calculates a table of the functions of n_f depending upon W and of the value of ϕ_f for the given flight conditions.

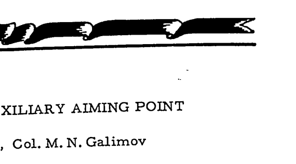


Fig. 1. Range aiming diagram.

In readying the bombsight, the following no-wind values are set in: n_f, γ thous., ϕ_f. After wind is determined in flight or after synchronization on the combat course in accordance with the obtained values of W or ϕ_f, the number n_f is corrected and then synchronization is repeated.

Depending on the type of bomb used, the lag is set in on the bombsight scale. This is done as follows. The lag value is set in on the bombsight for the whole scale, while the remaining number of thousandths is converted into distance and S_{ao} is reduced by this amount. Then, in accordance with formulas (1) or (2), n_f is computed. For this computation S_{ao} is no longer used, but rather its corrected (reduced) value S'_{ao}.

This same problem may be solved another way if the value of rotations n' from table 7 (supplement to the description of the bombsight for cases when the bomb lag exceeds the maximum allowable set-in value on the bombsight) is taken into account. Then T' is obtained as $\frac{5300}{n'}$.

Fig. 2. Diagram of geometrical relationship between turn angle and radius.

Then n_f is determined in accordance with the same formulas, except that T' — an arbitrary time of fall for the bomb chosen with provision for correcting the incomplete introduction into the bombsight of the actual bomb lag — is substituted for T. This very lag is thereafter compensated by the fictitious rotations of the bombsight's friction disc (n'). The fictitious rotations are limited by the outer value of the bombsight's rotation scale; therefore the possible planned short (for altitudes of 6000 - 8000 m) will be 3 to 4 km. However, when the lag which has been set in on the bombsight is reduced, it may attain the sum of $S_{ao} + \Delta$.

Range aiming differs in no way from the usual techniques of operating the bombsight. The most complicated element of aiming is the deflection setting which must insure the aircraft's flight along the line target — VTP.

For convenience of analysis, let us divide the whole process of deflection setting into two stages: the first being the "snaking" maneuver, made for the purpose of entering the planned line-up (30 - 40 km from the target at the far approaches); the second being the course correction after termination of the deflection setting in order to compensate for a bombing deflection error caused by an inaccurate entry onto the line target — VTP.

In order to execute the "snaking" maneuver, a table is prepared in advance of the turn angles depending on the amount of error in the approach and on the remaining distance to the target. The navigator determines the approach error $\psi°$ according to the DGMK-3 [long-range gyromagnetic compass], where the value of the planned course is obtained by taking into account the drift angle and the compass deviation. The target range D is obtained from the scope of the radar sight, by using the range marks or the measuring marker placed at 30 km.

The formula for computing the turn angles is derived from the geometrical function of the angle $\psi°$, D, and the turn radius (Fig. 2).

$$\cos \text{ UR [turn angle]} = 1 - \frac{D}{115\,R}\psi° .$$

The obtained angle values are tabulated.

Table of turn angles for R = 10 km

D km \ $\psi°$	4	6	8	10	12	14	16	18	20
50	33	42	49	55	61	66	72	77	82
40	30	37	44	50	55	59	64	68	73
30	25	32	37	42	46	50	54	58	61

The above maneuver enables the crew, during the initial approach to the target (VTP) made with an approach error, to select a final approach alignment without recourse to homing radio facilities. The corner reflectors of the VTP serve as a homing station in the final target approach, while the course angles of the target are read off from the azimuthal scale of the radar sight. If a repeat target run has been assigned, then the navigator raises the radar sight's antenna and, while turning to the target, he observes the corner reflectors of the VTP. By their position and by the inclination of the antenna, he determines the remaining turn angle to the target, communicating his findings to the pilot. The latter, on the basis of the readings of DGMK-3 (or GPK [directional gyro]) and the navigator's reports, by using the OSP [ILS] procedural turn, coordinates the planned course approach with the target approach on the scope of the radar sight.

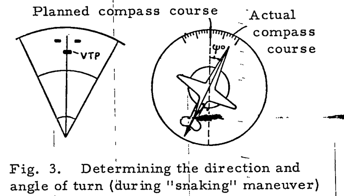


Fig. 3. Determining the direction and angle of turn (during "snaking" maneuver) according to DGMK-3 readings and VTP image on the scope of the radar sight.

As the aircraft rolls out of the turn, the navigator lowers the antenna,

securing the best image of the VTP corner reflectors. If, following the corrective turn to the target, the course does not coincide with the planned course, then the pilot, upon the navigator's order, executes the "snaking" maneuver.

The "snaking" maneuver — its direction and turn angle — is determined by the DGMK-3 readings and the VTP image on the scope of the radar sight (Fig. 3).

The figure represents the moment when the aircraft has entered the target approach, but when the actual course differs from the planned course by the angle $\psi°$. The "snaking" maneuver in this case is executed in the direction of the deviation reading of the actual course relative to the planned course on the DGMK-3. The turn angle is obtained from the table in accordance with the value of $\psi°$ and D km to the target.

When aiming is completed, the approach course may differ somewhat from the planned course; this characterizes the deviation of the actual aircraft path from the line target — VTP. In order to compensate for the bomb deflection error, the navigator must alter the course in such a way that the flight track passes through the planned target. The amount of correction is determined by the geometric function shown in Fig. 4.

Taking into account the fact that during the initial target approach the final approach is selected by "snaking", while when the plane is nearing the release point $\psi°$ actually does not exceed 4 - 6°, it is possible without any appreciable error to

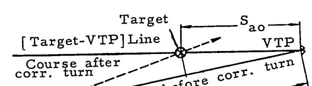


Fig. 4. Determining the amount of corrective turn.

express the relation:

$$\frac{S_{ao}}{H \cdot \tan\beta} = \frac{\eta°}{\psi°}\,;\ \text{then}\ \eta° = \frac{S_{ao}}{H \cdot \tan\beta - S_{ao}}\psi° , \quad (4)$$

where $\eta°$ is the angle of corrective turn to compensate for the bomb deflection error;
$\psi°$ is the final approach error in degrees;
S_{ao} is the distance between the target and the VTP;
β is the sighting angle to the VTP at the point of corrective turn;
$H \cdot \tan\beta$ is the distance from the VTP to the point of corrective turn.

If we are to assume certain fixed values, then the expression

$$\frac{S_{ao}}{H \cdot \tan\beta - S_{ao}}$$

in formula (4) may be expressed as a coefficient, K; then formula (4) will appear thus:

$$\eta^{\circ} = K \cdot \psi^{\circ}.$$

For sighting the VTP within the angle range $\beta = 63 - 56^{\circ}$, flight altitude 6000 - 8000 m, and $S_{ao} = 3 - 4$ km, the coefficient K will approximately equal 0.4 - 0.5. Since the values of ψ° are small, the corrective turn must be made by using the scale image of the corner reflector (its dimensions are dependent on the antenna radiation pattern of the radar sight). Thus, if $\psi^{\circ} = 4^{\circ}$, the corrective turn is held until the aiming point coincides with the image of the corner reflector. The corrective turn is made in the direction of deviation of the actual course indicator relative to the planned course on the DGMK-3, exactly as it is done in the "snaking" maneuver.

It must be borne in mind that, in addition to bomb deflection due to general causes, directional errors in target approach appreciably affect the accuracy of bombing by the above-indicated method.

When computing the planned final approach to the target, the navigator must know and take into account the amount of compass deviation.

Only those navigators who have been firmly grounded in bombing with the radar sight and who have acquired skill in aiming at a target designated by corner reflectors should be permitted to carry out bombing using an auxiliary point [VTP].

By using this method in our unit a large number of bombing missions with an auxiliary point has been carried out, and, as a rule, with good results.

The second bombing method consists essentially of setting up a planned bomb over relative to the VTP along the line VTP - target.

Inasmuch as the rotations of the optical sight's friction disc may be widely increased (this indeed being necessary for setting up a bomb over relative to the VTP), there was reason to believe that the possibilities of bombing with an over — provided that fictitious rotations of the friction disc are introduced into the sight — are quite extensive. Actually, it is not so. Since aiming with the use of a corner reflector is stable only for sighting angles up to $\beta = 20^{\circ}$, the maximum over is determined as the difference between the bomb deviation and the base of angle $\beta = 20^{\circ}$. That is to say, its value is equal to $A - H \cdot \tan 20^{\circ}$.

Consequently, when the aiming angles during bombing are small, the resulting over is slight, and this is obviously insufficient for solving a tactical problem. That is why, in order to set up a sizeable over relative to the VTP, it is necessary to resort to bomb release with a time delay t_{td} which depends on S_{ao} and W.

The time delay is reckoned from the point of the aircraft's initial approach to the aiming angle relative to the VTP. At the moment of initial approach to this point, the stopwatch is switched on, and when t_{td} has run out, the bomb is released.

The present method is not new. It has been tested in operation and adequately treated in training manuals.

Our navigators, when bombing with a time delay, make their initial approach to the VTP-target line in the same manner as has been described for the first method. However, the determination of the direction of the corrective turn for bomb deflection error compensation prior to bomb release, as well as the corrective turn itself, are made in the reverse order.

A RADIOTHEODOLITE

It is used for determining speed and direction of wind at altitudes up to 25 - 30 km in any weather, day or night, under stationary or field conditions. In design it is an ultrashortwave radio direction finder which measures the azimuth and elevation of the portable ultrashortwave transmitter being tracked. The transmitter is released into free flight attached to a weather-balloon envelope filled with hydrogen.

When the radio transmitter being tracked is operating in conjunction with the radiosonde, the radiotheodolite makes it possible to carry out detailed atmospheric soundings, to determine air temperature, pressure, and humidity, as well as wind direction and velocity right up to the radiosonde's ceiling.

In free flight, the radio transmitter transmits signals which are picked up by the radiotheodolite's receiver. Simultaneously with radiosonde signal reception, the transmitter's bearings are taken to determine its angular coordinates (azimuth and elevation). The angular coordinates of the tracked radio transmitter are determined by the radiotheodolite's antenna system operating on the equisignal zone principle.

The signals from the tracked radio transmitter, picked up by the receiver, are used on two separate channels: angular coordinate indicator and aural reception of the radiosonde's signals.

NIGHT LANDING OF A BOMBER ON AN UNILLUMINATED RUNWAY

Military Pilot First Class, Maj. S. O. Prokhorov

There is no need to argue the point that it is important that the flying personnel of any branch of aviation learn to land, not only on an illuminated airfield, but also on a blacked-out field, using for this purpose the aircraft's landing lights.

However, it is natural that, when training bomber aviation pilots in the technique of such landings, certain unique features are encountered. They are the necessary concomitant of the recognized difficulty involved in acquiring the requisite habits (determining, by reference to a point of light, the distance to the ground, the altitude for initiating roundout and level-off).

Present-day airfield radar facilities greatly simplify the approach and landing computation for all types of aircraft on an unilluminated airfield runway. In connection with this we should emphasize the fact that such a landing is most suitable where there is a system of glidepath beacons which provides for a precise aircraft approach to the runway.

In our unit the method of training the flying personnel in landing with landing lights on a blacked-out runway has been by now quite well organized. Provisions have been made for training flights in a combat-trainer aircraft and for practice flights in a combat craft. Flying personnel who fly day and night missions under adverse weather conditions are eligible for instruction and practice, eligibility being on a strictly individual basis.

At first training and practice flights are made with the runway lighting system on. In the course of two flights the instructor shows the pilot how to estimate the line of the runway lights and the point for beginning the roundout. During the ensuing flights, the pilot practices in a combat aircraft, going over the elements of landing.

Only after this do we begin training flights with the runway illumination turned off. The instructor's task is to continually check on the trainee, to focus his attention on correct sequence in operating the cockpit equipment, on the order of attention transfer, on the special features of the glide after the fourth turn, and on determining the altitude for beginning the roundout.

Prior to night flights, landing light alignment on all operational aircraft is carefully checked, since correct alignment facilitates landing. When the landing lights are fully extended their beams should converge at a point 50 - 60 m in front of the plane on its axis.

During night landing on a runway without floodlight illumination and without the landing light system operating, the following are set up: an illuminated tee, two direction lights at the airfield boundary for maintaining the heading at takeoff, and one light designating the point for beginning roundout. Since the moment of determining the altitude for beginning roundout is most crucial, this point must be very conspicuously

designated.

Along with landing technique we work on takeoff with extended landing lights; the latter presents no difficulties for the pilot, since the terrain ahead is quite visible by the light of the landing lights. Heading is maintained by reference to the direction lights at the edge of the airfield and by the changing aspect of the terrain in the illuminated path just as is done in daytime. Takeoff is possible even without switching on the landing lights. A special feature of takeoff with landing lights is the fact that the change-over to instrument flying is made after the landing lights are turned off and retracted. They must be turned off at an altitude of from 15 to 20 m, taking into account the pilot's visual adaptability. It is very important to turn the lights off first, and only then to retract the landing light, since landing lights which have not been turned off distract the pilot's attention during their retraction (the light beam shifts sideways from the aircraft axis).

Although the approach, the computation, and the landing with landing lights for an unilluminated runway is more difficult than for an illuminated runway, still with a high degree of training this difference is eliminated. The difficulty of a landing approach is due to the absence of check-points (lights), by reference to which the pilot may assume the desired heading. It is impossible, even from a tight pattern and with good visibility, to determine the heading by reference to the landing T. Therefore, in order to make the landing, it is necessary to make use of radar landing system facilities.

The landing computation is checked against the homing radio stations and the light which marks specifically the point for initiating roundout. The inner beacon serves as a good check point for checking the computation. With a correct computation the beacon is passed at an altitude of 70-100 m. In the course of the glide, the pilot must place the aircraft in such a position that the glide path is directed towards the roundout point. For this purpose he holds the light (point of light) which marks the start of the roundout in the center of the cockpit windshield, permitting it neither to rise above nor sink below the aircraft. At an altitude of 100 m the landing lights are turned on (they must be extended in advance, either before or after passing the outer beacon). Then the pilot gradually decreases the angle of glide and at the same time he increases the engine rpm in order to maintain the desired speed.

The aircraft is flown on instruments (special attention being given to flight altitude) up till the moment when the pilot can clearly see the ground by the landing light illumination. Only after this does he relax his constant monitoring of the instruments which indicate the aircraft's attitude; nevertheless he continues watching his speed and altitude (periodically he shifts his glance from the ground to the instrument).

Depending on the transparency of the air, the ground will become visible at an altitude of 100-50 m, and its illumination will increase with descent. The aircraft is rounded out at an altitude of 8-10 m and the landing is made just as in daytime.

Our flight experience shows that there are even fewer rough landings made when using landing light illumination than when using runway floodlights. This is explained by the fact that the pilot looks only in the direction of the landing lights without diverting his attention to the sides as happens when a flight is made with floodlight landing illumination.

During night flights various weather conditions have a unique psychological effect on the pilot — hence the idiosyncrasies in computation and landing. Thus, on a moonlit night with good air transparency, flying presents the pilot with no difficulties. The aircraft is flown by visual reference. The approach and landing computation are made by using radar facilities, but, in addition, by also using landmarks for cross-checking.

Landing has this special feature, namely, the landing light illumination diffuses; therefore the ground is visible at much closer range and there is inadequate contrast. While the pilot judges his altitude, his attention is distracted by objects on the ground which are illuminated by the moon, as well as by their shadows. As a result, he often finds it difficult to determine the precise moment for initiating roundout.

On a dark moonless night, with good air transparency, conditions are altogether different: it is difficult to determine visually the altitude and the range of the illuminated check point. Landing approaches are made on instruments while using radar facilities as well. Computations are checked by reference to the inner beacon and the point of light indicating start of roundout. Good air transparency improves visibility within the landing-light beams and the ground is quite visible.

When is it easier to fly a plane? By moonlight with visibility of 2-3 km and dense haze, or on a dark night with the same visibility and haze conditions? Such a question presented itself to our pilots. They are all pilots first class, instructors, with a wealth of experience, who have done extensive all-weather flying. And still some asserted that it is easier to fly an aircraft on a moonlit night than on a dark night, while others asserted the opposite. It seems to me that on a moonlit night with limited visibility (heavy haze) the pilot is much more distracted from maintaining his flight regime. This is due to the habitual tendency on the part of the pilot to observe anything outside the aircraft. Moonlight diverts his attention from the instruments; he tries to see the moon or the "horizon", but the silvery veil of moonlight obscures everything. The moon is not clearly visible; it appears as a vague diffused spot. When making any change in heading or attitude, the cockpit and instrument panel illumination change; the cockpit canopy throws fleeting shadows. All these unusual features, as well as the effect of the darkness and the cockpit illumination, produce a marked tension in the pilot which affects the quality of his piloting.

In marked contrast to this, flying on instruments in a closed cockpit may serve as a good example. In this instance, the pilot's attention is not distracted by anything — therefore there are no appreciable deviations. Hence we may conclude that, when flying an aircraft on a dark night with limited visibility, the pilot's attention will be concentrated in the same way as it is in a closed cockpit when flying on instruments alone, since he sees nothing beyond the cockpit. And this means precisely that there is greater assurance of maintaining the flight regime than when flying on a moonlit night. Such have been the observations made in the course of my work as an instructor.

A unique feature of approach, computation, and landing with limited visibility, on a dark as well as on a moonlit night, consists of a complete absence of horizontal and vertical visibility at certain altitudes. The approach is made on instruments alone with obligatory use of landing systems. Computation and landing with landing lights are often complicated, and sometimes become even impossible, since switching on the landing lights produces a luminous screen which hinders judging one's distance to the ground. The ground is visible from low altitudes of approximately 50-30 m.

A rapid descent of the aircraft cuts down the time which the pilot has at his disposal for determining the altitude at which to begin the roundout. As a result of his tension, he may jerk at the control column, and this in turn will complicate the landing

procedure. From the foregoing it is possible to conclude that, upon passing the inner beacon, the glide angle must be decreased, while the engine rpm must be correspondingly increased in order to maintain the required speed.

Landing with landing lights is not permissible under conditions of dense haze, high humidity, rainfall and snowfall. The operations officer must switch on the landing floodlights for crews which encounter such conditions. Here we might state that under such conditions blackout is not of primary consideration, since the floodlight illumination is visible only at short range.

In all instances when the pilot lacks confidence in effecting a safe landing with limited visibility, he must, without fail, request the operations officer to switch on the lighting system and the floodlights.

Just a few words about landing with a single landing light. Taking into account our night-flight experience, we can say that landing-light failure hardly ever occurs. Still it is possible that one of them may for some reason go out. The pilot must not in this event lose his composure — the landing is quite feasible with one landing light. For instance, on one occasion at night on an Il-28 aircraft the left landing light burned out. Landing conditions were quite difficult: cloud cover — 10 points [10/10]; ceiling of overcast — 400 m; visibility — 5-6 km. Nevertheless, the pilot managed to make a good landing (the runway lights were switched on). According to his report, when landing with a single landing light the main difficulties involved only judging the correct altitude for starting the roundout as well as a somewhat poorer visual contact with the ground during level-off.

A less experienced pilot in such circumstances must be assisted by the operations officer located at a mobile alert command post who not only monitors the landing, but the altitude for roundout and final landing approach as well.

The ability of the Air Force flying personnel to fly under the most complex conditions is a sure pledge of constant perfection of skill amongst an ever-increasing number of pilots. Regular night flights for polishing up the technique of landing with landing lights will further raise the level of combat preparedness in the units and outfits.

SUPERSONIC AIRCRAFT ENGINES

Col. A. N. Nikolayev

The transition to high supersonic flight speeds has put a number of complicated problems before designers and scientists, particularly with regard to improving aircraft engines, since their development is the key to progress in aeronautics. In the last 10-12 years turbojet engines have become firmly established in aviation. At present, designers in different countries have achieved considerable success in improving such engines and, as a result, aircraft speeds in horizontal flight have by far exceeded the speed of sound. Now designers are solving the problem of building engines which make it possible to fly at speeds 2. 5-3 times the speed of sound.

What are the means of improving engines? What should aircraft engines really be? Will the engines be essentially new types of power plants or will the tested and widely recognized turbojet engine be used in a specified speed range? Definite opinions on these questions have been formed in many countries.

Formerly some specialists maintained that even at speeds corresponding to M=2-2. 5, ramjet engines were to be preferred. It turned out that the ordinary turbojet engines are also suitable for considerably greater speeds. These capabilities can be realized simply by further improvement of the turbojet engine rather than, as was thought earlier, by conversion to athodyd and liquid fuel rocket engines, which are more practicable at high speeds and high altitudes of flight. (Fig. 1)

In flights at supersonic speeds, it is necessary that the power plant have the thrust required to overcome the tremendous drag. The simplest method to increase the thrust is to increase the consumption of air by the engine, since the thrust is directly proportional to the consumption of air, all other factors being equal. The second method is to increase the speed of the air in the engine. This is achieved by increasing the pressure and the temperature of the thermodynamic cycle, including an additional heating of the air in the afterburner. In the latter case the turbojet engine consumes 3-4 times as much fuel as an engine without afterburner. Nevertheless, this is advantageous for many types of aircraft, since the thrust is sharply increased for the same dimensions and for a comparatively small increase in engine weight.

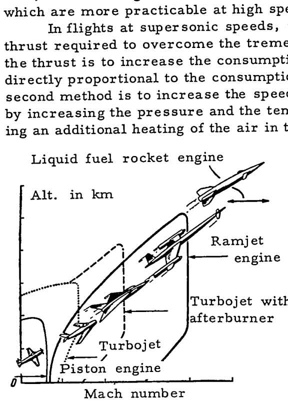


Fig. 1. Diagram of the increase of ceiling and speed of flight as a function of the type of power plant.

One of the primary ways of perfecting the turbojet engine is considered to be the improvement of the operation of the compressor, the turbine, and the afterburner. To draw a large volume of air through the engine, the height and tip speed of the blades are increased in many designs while the rotor hub is made smaller and a number of other improvements are introduced to increase the speed of the air flow.

Considerable advantages are achieved with a simultaneous decrease in the weight of the compressor rotor and the increase in its capacity to force great volumes of air. Judging from the reports in the literature, many turbojet engines in production have rather large comparative dimensions of the compressor hub (the ratio of the hub diameter to the outside diameter of the compressor port). The increase of the annular section due to the decrease in the hub diameter is very effective. For instance, by this method, the engine thrust was increased, in one case, from 3200 to 4500 kg.

The total increase of air pressure in the compressor depends both on the compression stages as well as on the increase in pressure in each of the stages. If the degree of compression is increased by one stage, the number of stages decreases. As was mentioned in the literature, the pressure ratio was raised by 15% in one engine when the tip speed of the compressor blades was increased from 305 to 427 m/sec. The disadvantage of this method lies in the considerable increase in blade stress and in the increased speed of the air flow in the compressor, which may lead to great losses and "surge".

Special interest was roused by engines with axial flow compressors. In order to further increase the flight speeds, designers must solve a number of new problems in the process of designing and developing the axial flow compressors for turbojet engines. First of all, a wide range of operation of the compressor is essential. For an engine, designed to perform at a constant physical number of revolutions, these revolutions may change from 100% at takeoff to 70% in flight at speeds corresponding to M=3. Such fluctuations in the number of revolutions are caused by an increase in air temperature at the engine intake as the flight speed increases:

$$n_{giv} = n\sqrt{\frac{288}{T}},$$

where n_{giv} is a given number of revolutions.

Fig. 2 gives the characteristics of a typical compressor (the pressure ratio is plotted along the x-axis, the air consumption along the y-axis).

From the graph, it can be seen that a given air consumption drops with the decrease in n_{giv}. In general, this drop will be greater percentage-wise than the decrease in the number of revolutions.

At the design point A, at 100% of number of revolutions, all stages will work close to maximum efficiency (when the compressor is working at the design point, each stage of it is working at its own design point).

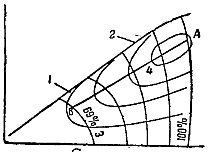


Fig. 2. Compressor Characteristics
1-Curves of constant kpd [efficiency] 2-Limit of pumping; 3-Curves of constant given revolutions; 4-The work line of the engine.

When the operating point of the compressor is displaced to point B, all its stages will work outside the design range. In this case the first stages will approach the pumping limit while the final stages will recede from it and approach the cutoff regime. This is explained by the fact that the compressor is designed for a prescribed degree of compression and the corresponding increase in density. Therefore, when the condition of continuity is taken into account, it is necessary to design the air-gas flow area of the compressor with a definite ratio of the flow sections at the input and the output. When the compressor begins operating at the lower revolutions mentioned, the degree-of-pressure increase, and consequently, the degree-of-density increase, become correspondingly smaller. But the flow sections of the compressor remain unchanged.

As a result, a given consumption of air in the first stages is lower than that at the design point and in the last of the compressor stages. This is why the first stages begin to approach pumping limit regimes.

With a slight degree of pressure increase in the compressor, a greater change in a given number of revolutions is possible before "surge" takes place in the first stages; whereas at a high degree of compression a slight change in a given number of revolutions causes pumping in the first stages while the final stages may begin to operate in the cutoff regime.

An engine designed to operate at high flight speeds must have a lower overall pressure ratio in the work cycle, and hence its specific consumption of fuel will be greater at subsonic flight speeds than that of a specially designed engine.

There exist several methods by which the requirements of the compressor's operating capabilities over a wide range can be met. One of these is the use of a device to change the setting angle of the inlet guide vanes. By turning the blades of the guiding device, each stage can be adapted to the new flow conditions and thereby its operation can be brought closer to the design (optimum) regime.

Another frequently employed method of regulation is the bleeding of air into the atmosphere. The principle is rather simple. If the first stages, as mentioned above, approach the pumping regimes, this condition can be alleviated by passing a great volume of air through the first stages. But because the final stages are unable to pass it, the necessity arises of opening special ports somewhere in the center of the compressor; this will permit an increased consumption of air through the first stages as compared to the last stages. The inefficiency of this method is due to loss of energy. If an increase in weight is acceptable and special conduits are installed, the air can be passed into the afterburner of the engine and used for additional burning of fuel.

In conjunction with this, it is possible to change the number of revolutions of the individual parts of the compressor rotor to prevent pumping in the first stages at low given revolutions. Reference is made here to the change of a given number of revolutions in the first stages in accordance with the increase in flight speed. This makes it possible to achieve operations of the first stages of the compressor under optimum conditions throughout the full range of flight speeds. Such an effect is very similar to the one obtained by regulating the angle of the inlet guide devices.

It is possible to choose a different approach: to maintain the large number of revolutions of the first stages and assume that the number of revolutions of the final stages will increase with the increase in the flight speed. The choice of the most efficient combination will depend on the function of the engine.

Thus, in engines designed only for flight at supersonic speeds, a relatively low degree of pressure increase in the compressor at takeoff is chosen.

If it is necessary to have low specific fuel consumption also at subsonic flight speeds, higher pressure ratios in the compressor will be required. To enable the engine to work over a wide range of speeds, a combined method of regulation may be used.

High speeds can cause distortion of the air flow through actual input ducts and have a detrimental effect on the operation of the compressor by shifting the limit of the pumping regimes in an unfavorable direction. The pumping margin in the pick-up regime is thereby decreased, while pumping sometimes takes place even in the established operating regimes.

The distortion of the flow is often the cause of an increase in vibrational stress in the blades and leads, in some cases, to an increase in gas temperatures before the turbine at maximum operating regimes.

Specialists are of the opinion that increase in temperature and pressure at the intake due to ram compression in supersonic engines becomes increasingly important in stratospheric flights. At such speeds compression due to ramming is utilized and there exists the possibility of developing engines of smaller specific weight.

One of the main problems of supersonic flight which causes additional difficulties in achieving reliable operation of all units and systems of the turbojet engine is the increase in air temperature in the compressor. Thus with a degree of boosting equal to 9, in flights at the speed of sound at altitudes of over 11 km, the air enters the compressor at a temperature of about 15°C, and leaves it at about 260° C. Such a temperature is not considered high for modern designs. However, if the same engine operates in flight at speeds three times the speed of sound, the air will enter the engine heated to a temperature of the order of 340° and leave it at a temperature of about 600° C, which will require not only additional modifications in design, but also high-strength materials. The greatest difficulties in designing a supersonic turbojet engine are encountered in the development of improved turbines to rotate the compressor. The necessity of a high rate of consumption will make the stress problem in the turbine even more difficult. The increase in operating temperatures of gases in the turbine by any significant amount will require cooling not only of blades but of the wheel itself.

With gas turbine engines of all types, especially in the turboprop and supersonic turbojet engines, the main factor which limits their performance is the maximum permissible temperature of gases at the turbine intake. Even though, since the development of the first turbojet engine, the temperature of gases at the turbine intake has increased by slightly more than 100° C, the improvement of design methods of axial-flow compressors has led in the same period of time to an almost threefold increase in the thrust-to-weight ratio of the turbojet engine and to an almost tenfold increase in specific forward thrust. The rate of improvement of these factors is now slowing down, and for further substantial progress in engine design a solution of the problem of the increase in working gas temperature is considered essential.

With the increase in the M-number, the gas temperature at the turbine intake which corresponds to the minimum specific consumption of fuel by the turbojet engine increases. Especially sensitive to the gas temperature are the specific weight and forward thrust of the turbojet engine at supersonic flight speeds. This has rather great significance for long-range high-speed aircraft. For instance, for a long-range aircraft (duration of flight of the order of 5 hours), at cruising speeds corresponding to M=2-2.5, the optimum gas temperature is 100-300° C higher than that for the conventional modern turbojet engine. For short-range interceptor aircraft with turbojet engines equipped with afterburner, the increase in gas temperature can give a great advantage in operation without afterburning, while the advantage of such an increase will be less when the afterburner is turned on. A high-temperature turbojet engine can develop the same thrust as a turbojet engine with an afterburner with a 25% reduction in specific consumption of fuel (Fig. 3). Especially advantageous is the increase in gas temperature in the turboprop engine for flight in the stratosphere at speeds of 700-800 km/hr. Thus the increase in gas temperature at the turbine intake from 1100° to 1400° can reduce the specific fuel consumption by about 10%.

The main and the most difficult problem, on the solution of which the development of high-temperature engines depends, is the construction of high-load turbine blades. There are two ways of solving it: the development of new structural materials and an effective cooling system. The use of nickel and cobalt alloys as well as ceramic materials combined with metals [cermets] for blade materials makes it possible to raise somewhat the temperature of the turbine blades.

In recent years much attention has been devoted to the development of new materials based on the principle of the combination of metals with heat-resistant compounds. Such alloys do not change their properties if heated to operating temperatures and cooled again. They are sufficiently strong to withstand at these temperatures the stresses due to centrifugal forces on the rotating parts of the turbine. In addition, parts made of these alloys show little change in their dimensions in operation and are resistant to heat fluctuations and mechanical dynamic pressures. The gas temperature can be increased if the turbine blades are cooled.

Several cooling methods are known. With liquid cooling the heat conducted away from the blades is absorbed by water or fuel. In combined liquid-air cooling, the heat is conducted away from the blades by a liquid which is cooled in a radiator exposed to the oncoming stream of air, or in a heat exchanger located between the compressor and the combustion chamber. Air cooling of hollow blades can also be used.

If the engine passes more air per square meter of frontal area and the compressor compresses this increased volume of air, the engine's combustion chamber must also be improved, since the amount of fuel which must be burned per unit time will increase.

In modern engines the gas temperature before the turbine is equal to 800-900° C. At this temperature the combustion products contain considerable amounts of unused oxygen; therefore the possibility exists of injecting an additional amount of fuel in order to increase the engine thrust by burning the fuel behind the turbine in a special afterburner.

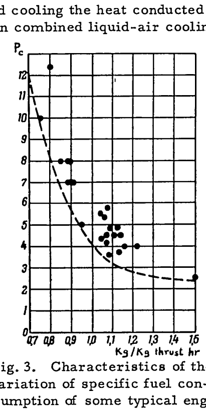


Fig. 3. Characteristics of the variation of specific fuel consumption of some typical engines.

Depending on how completely the free oxygen is utilized and on the flight speed, the engine thrust will increase. In this way, afterburning can give a considerable increase in thrust required for supersonic flight. It is therefore not accidental that the improvement of methods of afterburning became one of the essential tasks of aircraft engine building. As is pointed out in the literature, at temperatures of 1730-1750° in the afterburner the static thrust of the engine close to the ground increases by 35%. At the flight speed corresponding to the speed of sound this increase is 69%; at twice the speed of sound it is 105%; and at three times the speed of sound it is 219%. This increase in thrust takes place as the result of the difference between the exhaust speed of the stream with the afterburner turned on and the flight speed. Afterburning of fuel is widely used in all modern aircraft equipped with jet engines. Specialists consider that turbojet engines with afterburning may be expected to be used effectively up to flight speeds corresponding to M=3.5 and higher. Let us note that the limits of speeds and altitudes for different power plants are not yet permanently established, but change continually as new knowledge accumulates.

The characteristics of power plants are chosen with the type of aircraft and its flight regime in mind. Take, for instance, an engine for an interceptor aircraft with short flying time. This engine is, of course, different from the engine in a bomber aircraft; its equipment and control system are more complicated. In addition, the main part of the work of compression is done in it at very high speeds by using ram pressure, not the compressor. All this makes it necessary to design the aircraft and the engine as a unit.

Intake of air into the engine and exhaust of gases become quite important for the aircraft. The problem of intake devices and of the change in area of the exhaust nozzle involves the necessity of achieving high efficiency of the turbojet engine over a wide range of operation from takeoff of the aircraft to supersonic flight speeds at high altitudes.

It is necessary that the jet nozzle and the exhaust of gases from it be controlled in accordance with the operating regimes of the engine and the flight conditions. But such control often involves considerable angular and axial displacements and great stresses; therefore special devices are required to control them. Mechanisms which change the gauge of the jet nozzle operate at very high temperatures and this further complicates the solution of the problem.

The location of the engines under the wing on pylons gives rise, as it is sometimes thought, to additional design difficulties at high supersonic speeds and causes additional drag. Often it is recommended that the engines be located at the wing tips since this fact, as well as the installation on a pylon, makes it possible to achieve the most favourable characteristics of air intake and gas exhaust from the jet nozzle. The disadvantage of such design is in the asymmetry in thrust in the case of failure of one of the engines and in the necessity of precise balancing of thrust in flight. The widely used installation of engines in the fuselage allows axial intake of air but at the same time its intake duct takes up too much room. But side airscoops located at the wing roots also have quite wide-spread application and they permit the use of the nose part of the fuselage for equipment.

As a result of the increase in aircraft flight speed there is an increase in landing speeds. Acute necessity arises to use special means for decreasing the length of the landing run. One of the more successful means at present is considered to be the reversing device, i. e., creation of reverse engine thrust. By using the reversing device conditions can be created under which the counter-thrust will be 50% of the maximum thrust developed by the engine under normal conditions. The resultant of the counter-thrust is directed forward, since the gases exhaust at an angle of 45° to the engine axis. The weight of such an installation is negligible — only about 3-4% of the total weight of the engine, while its advantages are great. With the reversing device in operation, an aircraft which ordinarily travels 800-1000 m after landing requires only 400-500 m for the landing run.

Reverse thrust also allows an instantaneous or gradual transition from maximum thrust regime to a regime in which the direction of the air stream is changed; this gives rise to a considerable counterthrust. Because of this the aircraft can descend to the strip with a greater vertical velocity. Thus landing accuracy increases. In flight the reversing device can serve as a speed brake to facilitate steep

dives and to increase the maneuverability of the aircraft in combat. It also makes possible a rapid regrouping of aircraft in formation flying. According to the literature, recent efforts of designers are devoted to the development of light and compact means of reversing the engine thrust without losses and parasitic drag, capable of operating under any conditions.

With the increase in combat altitudes of modern aircraft the necessity arose of studying more carefully the types of fuel used in aviation. It is known that kerosene boils at flight speeds equal to 2.3 times the speed of sound in the tropopause and at double the speed of sound on the ground. Gasoline boils at flight speed corresponding to 0.8 the speed of sound, at an altitude greater than 12 km, and at a one and a half the speed of sound on the ground. Aircraft flying at an altitude of 15 km may lose up to 20% of their fuel through evaporation if the fuel tanks are not air-tight. At high supersonic speeds it is impossible to use the fuel as a heat absorber; rather there is danger of autoignition, since at speeds equal to 3.5 times the speed of sound the temperature of the aircraft skin may reach 430°C.

Therefore the fuel in a supersonic aircraft may require cooling. In the air scoops and the compressor the drop in temperature may be of the order of 500° C, and if the fuel is heated by the heat from the aircraft skin, the vapor pressure may become excessive. This leads to difficulties with compression, pumps, and automatic systems, especially at high altitudes when the pressure of the surrounding air is not high (at an altitude of 11 km it is equal to 0.23 kg/cm^2) and the fuel consumption is relatively decreased. In this manner the use of volatile and easily combustible fuels militates against the requirement of storage in hot tanks and feeding through hot pipes without evaporation.

In different countries work is being done on the development of new fuels with increased efficiency per unit weight as well as per unit volume, since this is of decisive importance for the increase of the flight range of supersonic aircraft.

Recently pentaborane (liquid hydride of the light metal boron) has been regarded as the best chemical fuel; it is 10% lighter than gasoline, whereas its efficiency is 54% higher.

Rather important is the high speed of flame propagation of this fuel, which is several times as great as that of the hydrocarbon fuels. Combustion chambers in the engine can be shorter, making it possible to design a shorter and lighter engine. The duration of flight of a fighter aircraft using pentaborane is 20% greater than when conventional fuel is used.

However, the use of new fuel types is accompanied by many and varied difficulties. In particular, engine performance, when operating on pentaborane, is improved due to the higher combustion temperature. The temperature is so much higher than usual that the combustion chambers have to be modified. This in turn puts more stringent requirements on the materials and gives rise to the necessity of a changeover to combustion chambers with ceramic linings or chambers made totally of ceramic material. It is pointed out in some sources that ~~maximum speeds and~~ high flight altitudes will be reached by using afterburners with chemical fuel when the bomber aircraft approaches a target, while the cruising flight will take place with the aid of conventional turbojet engines operating on standard fuel.

Independently of the work done in the field of application of nuclear energy to aircraft propulsion, the need for chemical fuels for present and future military aviation is steadily increasing, while the transition to supersonic speeds and very-high altitudes is impossible without special new types of fuel. Many specialists point out that, basically, only chemistry is capable of providing long-range supersonic flight with turbojet engines. Conventional kinds of lubrication materials cannot be used in the turbojet engine, which tends to increase its operating temperatures. Therefore new synthetic lubricants, capable of performing at high temperatures, must be found.

The development and improvement of turbojet engines best suited for applications at high supersonic speeds does not, of course, preclude the development of power plants of other types. As flight speeds equal to 3 times the speed of sound are approached, and especially when they are exceeded, it will become advisable to install combined power plants in the plane. In this case, in addition to the main turbojet engine, a liquid rocket or athodyd engine will be installed. The liquid type rocket engine has no equal for the majority of guided missiles and obviously has a future in the field of application to piloted aircraft for which the flight range at maximum thrust has less importance. The liquid type rocket engine is the lightest engine, even though it is less simple than an athodyd engine: it has a very high fuel consumption and its thrust does not depend on speed and increases somewhat at higher flight altitudes. In interceptor aircraft the liquid type rocket engine will yield considerable improvement in the rate of climb, acceleration, and especially in high altitude performance.

It must be pointed out that additional engines can be used not only to increase the maximum flight speed and especially the aircraft's ceiling, but also for facilitating takeoff.

Some specialists think that liquid type rocket engines incorporated into combined power plants are the next logical step in the technique of interception and are the only effective solution in this particular area of application for combat aircraft. Thus an interceptor with a combined power plant has a good combination of high rate of climb and angle of climb, acceleration and operating ceiling as well as horizontal flight speeds. A number of specialists, on the other hand, are of the opinion that the liquid type rocket engines will be used as auxiliary engines for climbing and acceleration.

Special attention is focused at the present on problems involving the installation of the liquid type rocket engine in aircraft; a number of countries have developed special designs and means of insuring accessibility, of developing rapidly interchangeable power plant assemblies in one unit, of insuring detachability of pods with the liquid type rocket engine, of increasing the safety of integrating the engine with the aircraft configuration, etc. The liquid type rocket engines use oxidizers as fuel: liquid oxygen, nitric acid, hydrogen peroxide, and others. The fuel may be rather varied, including hydrocarbons, alcohols, and aromatic compounds.

A few words must be said about the athodyd engine. The athodyd engine is the simplest in construction of all jet engines. The air is compressed only because of the ram pressure of the air flow in the direction of the engine. It is necessary for the operation of such an engine that the exhaust velocity exceed the flight velocity. At low speeds the degree of compression of air is insufficient for satisfactory economy of operation of the engine.

At higher flight speeds, engine thrust increases and fuel consumption decreases.

The athodyd engine can be combined with the turbojet engine as an auxiliary burner (afterburner), while the turbojet and liquid fuel rocket engine are used for acceleration

at takeoff when the forward velocity must be increased, and the process of stable combustion and good thrust performance must be insured.

Such are some of the characteristics of modern jet engines.

However, nuclear power plants have the greatest potentialities for supersonic flight. The atomic engine will give the aircraft a vast flight range at high supersonic speeds and will give strategic aviation new and better flight characteristics.

PREFLIGHT SERVICING OF AIRCRAFT ARMAMENT

Candidate of Technical Sciences, Engineer Col. E. S. Markov

Armament specialists, in contrast to aircraft mechanics, radiomen and electricians, receive training usually only in servicing flights for target practice. Specialists in other branches, however, have an opportunity to train during preparation for any mission. This is why it is necessary to organize the training of armament technicians and mechanics during flights in order to increase their practical experience.

Especially valuable is the training during the servicing of the aircraft for repeat sorties; it makes it possible to improve the methods of technical maintenance of armament under the most difficult conditions, when the time for servicing is limited. We agree with the opinion of Com. V. A. Malygin, expressed in his article ("The Herald of the Air Fleet," No. 6, 1955), on making use of any group flight to train armament specialists. Even though it is sometimes difficult to set up training of this kind in the units, it is possible with sufficient perseverance to conduct such training periodically. It seems to us, that only in this way is it possible to achieve good practical training of armament specialists in peace time.

The methods of training in servicing aircraft armament for repeat sorties can be quite varied. For instance, armament engineers, officers L. B. Balagul, and I. P. Shvayakov always include in training the replacement and reloading of ammunition for cannons. To decrease the time necessary to prepare the armament for firing in large groups of aircraft, they use a specially equipped service truck. On it is assembled, in a definite sequence, all the necessary equipment for servicing the aircraft armament: batteries, a bottle of compressed air, portable tool boxes, all kinds of gear. The truck also carries ammunition. All this makes it possible to cut considerably the time spent in preflight preparation of the armament. In studying the experience of other units, we have rejected the use of the device designed to clean the barrels of the guns without prior unloading proposed by B. S. Vinnik in an article published by "The Herald of the Air Fleet", No. 10, 1956. This device, in our opinion, does not completely solve the problem, since it does not permit cleansing the chamber of lubricants and can lead, with careless handling, to damage of the parts in the breech mechanism, especially of the firing pin. Working with this device requires care and constant supervision.

In our outfits the regulation cleaning of the gun barrels before firing has been eliminated. Our armament specialists have learned to coat the lands of the barrel bore with a thin layer of lubricant. Armament engineers, officers L. B. Balagul, I. P. Shvayakov, and I. A. Nesterenko have been using this method for several years. The coating of cannon barrels combined with timely and proper cleaning reliably protects the bore of the barrel from corrosion.

In preparation of the armament for repeat firings, the lands of the barrels are always wiped clean, in order to remove dust, sand and foreign bodies. The fact is,

that in taking off and landing on a dirt air field, sand and bits of gravel find their way into the bores of the cannon barrels.

Speaking of armament, servicing the gun camera cannot be disregarded. It must be noted that the location of the gun camera on MiG-type aircraft is not quite convenient. The gun camera must be dismounted in order to wind the clock or set the hands. Because of frequent dismounting of the gun camera, its fire adjustment is affected. Thus it must be checked periodically, which distracts the armament people from other work.

We also take into account the fact that with time, the clocks used in the gun camera lose their precision, and their reliability decreases. This is the reason why we check, wind, and compare the clocks with a standard chronometer before takeoff, in addition to checking the electrical circuit of the gun camera. This serves as a prophylactic measure, so to speak, which prevents clock failures in the air. With such preparation of the gun camera, the error in the clock readings as compared with the standard clock, by which the time is set, will be minimal.

The signal flare containers are only loaded prior to flight. In every squadron (or group) one specialist is usually designated to load the flare containers in all aircraft. While the cannon and other armament are being readied, he usually has enough time to finish his work. The electrical circuit of the containers is checked on the day of preliminary preparation of the aviation equipment, and there is no necessity for additional checking, as we have learned.

In our opinion, the proposal made by officer V. A. Gayvaronskiy on the storage of the containers outside the aircraft merits attention. With such storage the time of preparation of the armament is not decreased, but on the other hand, better care can be taken of the containers. Of course, the containers can be better protected from corrosion indoors. But the trouble is that they belong to the non-dismountable aircraft equipment and therefore their storage outside the aircraft is not recommended.

The servicing of the aircraft armament after firing is divided by us into two stages. In the first, after the aircraft has landed at the end of the VPP [runway], the cannon are checked and disarmed if necessary. In the second stage, they are put in combat readiness, the armament is checked, ammunition reloaded, the sight and the gun camera readied.

Every airfield has a special area at the end of the VPP to which the aircraft are taxied and positioned in such a way that the armament barrels point in the direction of the safe sector. The armament specialists inspect the armament and always clear it. Then the aircraft are towed to the location where fuel and air are taken on. Such safety measures always pay off.

When flights are made by small groups or single aircraft, the second stage in preparation is carried out immediately after the first one. However, in training flights of single aircraft it is sometimes more convenient to load the ammunition, not at the end of the VPP, but somewhere else — for instance on the preliminary starting line — especially if the firing was done from one cannon, which can be cleared without lowering the gun mount. In this case the preflight servicing of the armament is done after the aircraft has been refueled and supplied with compressed gases.

Sometimes it happens that a large number of aircraft participate in gunnery missions; they land with short time intervals and the dimensions of the area on which the armament is cleared are limited. To avoid concentration of aircraft on the area, we clear the armament and carry out its preflight servicing only on one group of aircraft. The armament of the aircraft which landed in another group is rendered safe with the aid of safety devices. Subsequently the aircraft are towed to the area where they are refueled and supplied with compressed gases. Preflight servicing of the armament is done on the preliminary starting line or somewhere else as directed by the commanding officer.

We have discussed only a few of, in our opinion, the most vital details of the organization and execution of the preflight servicing of aircraft armament in our outfits.

ON A DIRT AIRFIELD

Senior Lt. Engineer M. F. Rebrov

It is an overcast windy day. The sky is hidden by leaden clouds which stretch like an impenetrable curtain reaching almost to the ground. How is it possible to fly in this weather? Rather recently flights in jet aircraft were usually cancelled in such weather. But with improved equipment and increased flying skill, they have become a common occurrence. This is the reason why the aircraft of the squadron in which officer K. M. Levankov is serving are ready any minute for takeoff. The aircraft are positioned on the starting line, fully supplied with fuel, air, and oxygen; the check lists are filled out and signed.

The fighter aircraft, used by the unit, has powerful engines and sources of electric energy; it has airborne radio and radar equipment with various functions, complex instruments and automatic equipment. All this requires not only daily painstaking maintenance, but demands of the technical personnel extra precision in work, thorough knowledge, an advanced technical background.

To organize the work efficiently, to teach the flying and technical personnel the efficient use of the new equipment are the principal tasks of the engineer. Almost all activity of the technical personnel takes place under his leadership. And even though the group works with confidence and zest, Levankov always has many things to take care of: finishing touches must be put on the work done on the aircraft, the current regulation inspections must be carried out, and at the same time combat readiness must not be sacrificed.

The aircraft specialist has neither the right nor the time to make mistakes; he must always give a precise answer, find the correct solution. The equipment does not tolerate slipshod treatment. Dynamic, fast-paced activity — full of challenging responsibilities — is Levankov's element. All his work is a continuous learning process, a great creative endeavor.

He got into aviation a long time ago and has been working now for almost twenty years in maintenance. All kinds of aircraft have passed through his hands. A great number of combat sorties were serviced by him, a great number of aircraft were tended by him during the Great Patriotic war. Communist Levankov has serviced aircraft on tactical air fields rapidly and efficiently under combat conditions.

The battle of Warsaw, the capital of the brotherly Polish people, comes to mind. The Hitlerites offered stiff resistance. The squadron in which Levankov served as senior technician used to fly up to thirty sorties a day.

Escorting, interception, ground attack, takeoff and landings on dirt. There were no failures and breakdowns for which the technical personnel were responsible.

Now the aircraft unit in which he serves is based on a field airdrome, but entirely different from the one in war years. In addition to a metallic takeoff and landing strip, there is a well-rolled dirt field. And although the notion that jet aircraft can only take off and land on concrete airfields has been disproved by experience, the idea of operating high-speed fighters from dirt fields has been regarded with doubt up until recently by many, especially by young pilots and technicians.

The engineer had to work especially hard when new jet aircraft arrived in the unit. As the first order of business, the design of the machine had to be studied, the technology of servicing and maintenance had to be mastered, the peculiarities of operation of every unit and assembly had to be understood.

The theory was hard to master. To do it alone would have been quite difficult, of course; but Levankov had help from senior comrades, the commanding officer, and the engineer of the unit.

He made his first acquaintance with the new aircraft at the factory and became deeply immersed in the study of the new equipment. He studied every detail with deep interest, wanted to know more in order to teach the flying and technical personnel the efficient operation of these wonderful aircraft.

It is hard to forget the day when the first takeoffs and landings were made. It is quite understandable that the excitement was much higher than before any other flight, since the takeoff took place, not from a concrete runway, but from an ordinary field. The engineer was worried as much as the rest. How will the machine behave, what units and assemblies should receive special attention? When revving up on the apron or taxiing to the start line, sand, dirt or gravel can get into the intake ports and damage the engine compressor and turbine blades.

Military Pilot First Class Lt. Col. A. Kh. Tuayev was the first to take off, then officers I. E. Babenko and P. I. Kuznetzov.

A green rocket rose from the SKP [alert command post] and immediately afterwards a silvery aircraft sped down the field marked by flags, raising a cloud of dust. In a moment it was airborne and zoomed into the skies, rapidly gaining altitude.

The first flights were successful. The equipment performed excellently. Now that the main difficulties of mastering the technical and flight operation of the high-speed jet fighter from a dirt airfield have been overcome, we would like to analyze and evaluate the tremendous work, the daring and perseverance of the pilots and technicians. Carefully servicing the machines for flights, they uncovered the peculiarities of flights made from a dirt airfield.

For instance, (on the aircraft of technician Lt. V. A. Alekseyuk) after landing on soft ground, kinks were observed in the landing gear fairings due to compression of tires. This defect was analyzed with all technicians present. It was clear to everybody that it can also appear on other aircraft. It was decided to clip the corners of the fairings. The factory was asked to take this into consideration. No more cases of this type occurred even when the machines landed on a snow-packed airfield.

The landing of high-speed aircraft on dirt involves great stresses on the forward strut of the landing gear. This did not go unattended in the squadron. The engineer gave a lecture to the technical personnel, explained the necessity of careful checks of the landing gear after every flight. Rigorous inspection helped to rectify in time the

defect in the glands of the front wheel strut on the aircraft of officer Alekseyuk, where they wore out prematurely due to high stresses, which led to spurting out of the hydraulic mixture.

Due to impact during landing on uneven ground and large stresses on the landing gear, the rubber glands of the shock absorbers wore out prematurely also on the aircraft of technician Lt. V. T. Lutikov. Two shock absorbers were replaced. Later it was shown by experience that the shock absorbers on the main struts of the landing gear need be replaced only after 100 flying hours, if the aircraft is properly operated by the flying personnel.

Levankov is present as a rule at the preliminary check-out and if the pilots have any questions on the operation of the equipment, he answers them on the spot. At one of the lectures the engineer explained how taxiing should be done on soft ground and pointed out the necessity of avoiding sharp braking of the front strut and explained to what this may lead. The pilots should also know that the great weight of the aircraft and the great momentum make themselves felt in braking on turns during taxiing, when the radius of the turn increases somewhat and the landing gear is under great stress. In retracting or letting down the landing gear at increased speeds the fairings of the main struts may buckle.

Captain of the maintenance service K. M. Levankov

At technical discussions which take place after every flying day, Levankov always analyzes the mistakes made in operation. Once, in climbing to the height of 12,000 m. at vertical speed, the pilot did not observe the time of maximum power operation of the engine and switched over abruptly to afterburning. The engine flamed out and he succeeded in starting it only after the aircraft dropped to 9000 m. The engineer discussed in detail this error and explained to what consequences it could have lead.

In classes held for the technical personnel, Levankov explains the design and operation of the various assemblies and systems of the aircraft with the aid of mockups, diagrams, and working installations. And then he shows them directly on the equipment the methods and ways of checking and operating it.

He also requires of his subordinates that they have a good knowledge of instructions and directions for the operation of equipment, studies with them all the manuals, and in this lies assurance not only of competent maintenance of the complex equipment, but also assurance of a more efficient utilization of it.

The operation of aircraft from a dirt airfield must be carried out with all its special characteristics in mind.

Once, during preflight inspection of aircraft, the engineer noticed a thick coating of grease on the piston rods of one of the machines. He ordered the technician to wipe the piston rods dry and explained to him that excess lubricant behaves as an abrasive when dirt and dust gets in it, and this causes premature wear and play in the working parts and articulated joints.

This is the reason why special attention is paid in the outfit to the removal of excess lubricant, and the ball bearings are lubricated with MK-8 oil, which is not capable of retaining grains of sand in the same number as is the Ts IATIM-201 lubricant. Other assemblies in the aircraft may fail due to the presence of foreign matter. For instance, after a mission a leak was once discovered in the cockpit of one of the aircraft. In correcting this fault, technician Lt. A. V. Vasil'yev found that the safety valve failed because there was dirt in it. Sticking of the wing flaps in the intermediate position is also possible due to the presence of sand on the guide rails.

During group flights an especially large number of foreign objects get into the intake port, together with the exhaust gases from the aircraft which are taxiing ahead. The specialists know that this leads not only to dents in the blades but also to plugging of filters of the centrifugal regulator of the air bypass band. Due to the failure of the control system, the band may not open and pumping will result.

To avoid such occurrences, the main part of the work is done in the unit immediately after the flight. No defect, no failure of the aviation equipment remains unattended and without a thorough analysis of its causes. Preflight inspections, on the other hand, are the final step in preparing the equipment for flight.

Taking account of the peculiarities of design of the aircraft and the low suspension of the auxiliary fuel tanks, the technical personnel of the squadron tries not to fill them to capacity with kerosene when takeoff and landing are made on moist and soft ground (the tanks may touch the ground, which creates a definite danger).

One of the contributing causes of an accident is a low standard of aircraft inspection on the part of the technical personnel. This is the reason why officer Levankov makes demonstration inspections periodically and supervises the work of the technical personnel. If the pilot has made no comments on the performance of the aircraft in the air, this does not yet mean anything, says he. There can be concealed defects, which have not yet manifested themselves, but will do so on the next flight, and they can only be discovered by a thorough inspection of the whole aircraft.

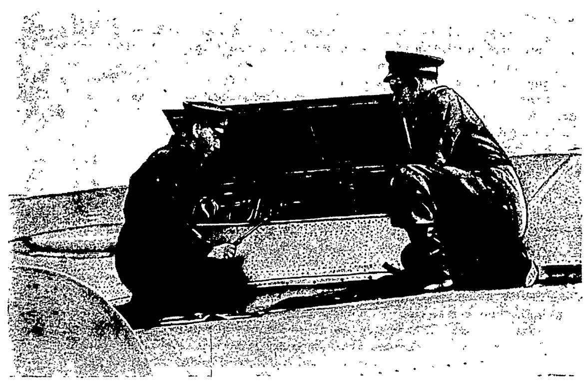
Once during tests on engines when the air bypass band was checked at revolutions in excess of 9700 rpm, one of the engines began pumping. A search for the cause ensued. It turned out that similar phenomena may occur due to a great number of dents or other damage to the compressor blades.

This is just the reason why in the squadron, principal attention is focused on the inspection of blades. With the aid of a special optical device and a lamp, the aircraft technicians check the condition of blades under the supervision of their engineer, eliminating in this way causes contributing to accidents in flight.

Another matter is also important. Landing the aircraft on dirt, the surface of which may have various rough spots, is accompanied by vibration and jolting which sometimes causes leaks in the oil, fuel, and hydraulic systems through breaks in the pipe lines.

The automatic release valve of an hydraulic system once became inoperative; in releasing the landing gear or the wing flaps the pressure in the system dropped to zero.

The glass of the cockpit canopy also requires special care. In order to avoid scratching the glass, it is wiped clean with a soft rag, since a lot of dust and dirt raised by the aircraft in takeoff is deposited on it.



V. E. Krivonosov (on the right) and U. S. Dorofeyev inspect an aircraft after flight.

In takeoff and landing of the aircraft on a dirt airfield, sand and bits of gravel get into the barrel bores and moving parts of the cannon, which may lead to their breakdown and to dilation of barrels.

A great deal must be done to ensure troublefree operation of the aviation equipment under such airfield conditions and intensive flying training. In carrying out inspections and routine regulation work, the technicians and electricians thoroughly check the external surfaces of the aircraft assemblies, armament, special equipment, radio and radar equipment, cleanse them of dirt, dust and old grease. All this makes it possible to prevent in time the occurrence of such defects as sticking of terminal landing gear signal switches, which is especially characteristic of the nose strut. They also carefully check the condition of the taxilight bracket, making sure it has not been knocked out of alignment.

In their work, the technical personnel of the squadron also ran into the following difficulty. Periodic checks of landing gear extension and retraction are required. To do this the fighter is placed on special jacks. On a concrete surface this does not present any difficulty. To lift the aircraft in soft ground, on the other hand, is very difficult, but a solution has been found. The specialists utilized steel plates or flooring which prevent the jacks from sinking into the ground; this is especially important when dismantling the tail section of the fuselage, when a redistribution of stresses on the landing gear struts takes place.

Under the supervision of the chief engineer of the unit a scheduled inspection of the aircraft was worked out in the squadron, during which the condition of the turbine blades of the axial flow compressor and the landing gear is checked, and every 10 days the gaps in the fairings are checked when retracted. To prevent breakdowns in the performance of the aviation equipment, overall inspections with disassembly of the aircraft are conducted. Often starting the engines with open hatches is also practiced; it is possible then to see many assemblies and check their normal operation.

Flight servicing is precise and well organized. If the chief engineer of the unit assigns a task, Levankov briefs every technician and electrician on it as well as the personnel of the maintenance group. Technical crews know how many sorties each aircraft must make, the nature of the mission, the duration of every sortie, and the interval between them.

Flying days can be very tense. A great deal depends on the coordination between specialists of all services. Thanks to the coordination of the work of technical personnel of Capt. Levankov's outfit and the drivers of special purpose vehicles, flight servicing for repeat sorties is well organized and servicing time has been reduced.

Levankov is an active Communist; he works actively with the men of the outfit, takes part in all theoretical conferences. The engineer carefully studies the men, helps the new men, encourages the industrious and the punctual, punishes those who deviate from the rules and regulations of technical maintenance.

The engineering and technical personnel must carry out many different tasks and the successful solution of the combat training problems put before the Air Force unit depends a great deal on how conscientiously and skillfully these tasks are carried out.

In a short time the technical personnel of the squadron has achieved great success. Aircraft technicians M. A. Tsimonenko, U. S. Dorofeyev, A. V. Vasil'yev, flight technician V. E. Krivonosov know new aircraft thoroughly and service them in an excellent manner.

Almost all mechanics in the outfit — L. V. Levchenko, P. E. Kulakov, V. D. Usachev, M. V. Fedayev, and others — have been mentioned in the order of the commanding officer. Squadron Engineer Capt. Levankov has also received many expressions of thanks. He was twice given engraved watches and cash awards for accident-free work.

The lull on the airfield gives way to activity. The pilots climb into cockpits, the technicians look searchingly for the last time at the silvery aircraft straining forward. The roar of powerful jet engines shatters the silence. The planes race one after the other along the runway and zoom into the sky. Aviation equipment, serviced by caring and skillful hands, is operating faultlessly.

ANSWERS TO READERS' QUESTIONS

TIME AND ITS RECKONING

Since 1 March 1957 new time zone borders have been introduced in our country.

In connection with this, some comrades have asked us to explain what the time zones are, why the necessity arose of introducing the new borders, how time is reckoned, and what rules exist for transition between one standard time and another.

Here we comply with their request.

It is known that the earth rotates continually and uniformly around its axis. The 24-hour day, the period of one complete revolution, is the basic unit of time which is subdivided into smaller parts: hours, minutes, seconds.

The result of the rotation of the earth around its axis is an apparent daily movement of the sun whose position in the skies gives the true solar time. This time, seemingly easy to determine from the sun's position, is nevertheless completely unsuited for practical use. The fact is that the sun's position shifts somewhat with respect to the stars, the result of which is that its motion through the sky is not completely uniform and on different days of the year its direction of motion is not the same. Therefore the true solar day is sometimes shorter, sometimes longer. Corresponding to the change in the day, the hours, minutes, or seconds become shorter or longer and if we were to live in strict accordance with the solar time, we would have to adjust our clocks almost daily, which even a most accomplished watchmaker cannot do. It is not surprising that famous Paris watchmakers in olden days wrote the slogan in their advertisements "The sun shows the time incorrectly".

The necessity to use the solar time, but in such a way that the units of its measurement would be constant, has compelled people to use in calculations the so-called mean sun, which is taken to be an imagined point, not existing in reality, and which performs a yearly rotation through the sky in the same direction and the same time as the true sun, but moving always uniformly along the celestial equator. The movement of this point on the celestial sphere averages out, as it were, the movement of the true sun and makes the 24-hour time periods equal.

All clocks are thus adjusted to correspond to the mean sun and consequently show the mean solar time. The greatest difference between the true and the mean time occurs in February and November when it amounts to about 15 minutes; in April, June, September, and December the difference is zero. The time is different on different meridians of the globe at the same instant. When it is noon in Moscow, it is past noon on the meridians east of Moscow and before noon on the meridians to the west. The earth rotates from west to east; therefore the meridians located east of Moscow pass under the sun earlier than the Moscow meridian.

The total revolutions of the earth through 360^o occur in 24 hours; consequently the earth rotates through $\frac{360^o}{24} = 15^o$ in an hour. In other words, the meridian located 15^o east of Moscow passes under the sun exactly an hour earlier than the Moscow meridian. Noon and all other instants of time occur also an hour earlier there. If the meridian located 15^o west of Moscow is compared with the Moscow meridian, obviously all instants of time will occur there one hour later than in Moscow. The fact that every geographical location has its own "local" time has in practice made the contacts between people living in different populated areas very inconvenient, especially when using the railroads, aerial transportation, or the telegraph.

Indeed, if all of us were to live on local time, a continuous readjustment of the clock hands would be required in traveling from point to point to make the clock agree with the local time. Even in one populated area, points with different geographic longitude have different local time.

Therefore different countries began a gradual introduction of standard time in their territory in the second half of the 19th century, this time usually taken to be the local time of the capital or of the main astronomical observatory. In our country standard time was introduced on the railroad before 1919. It was taken as the local time in Petersburg. Every town, however, lived on its own "average" local time: hence the distinction between "town" and "railroad" time. In England the time reckoning was set by the Greenwich meridian (near London) where the main English observatory is located; in France the time was taken as the time in Paris, 9.5 minutes ahead of Greenwich time; in Italy the time was taken as the time in Rome, 50 minutes ahead of Greenwhich time, etc. But with the development of widespread industry and with the growth of socio-economic ties this standard time for each country proved inconvenient in practice, especially for countries such as ours which have a great extent from east to west. In addition, such time reckoning introduced the necessity of complicated conversion and confusion into international relations. It became necessary once more to regulate uniformly the reckoning of time.

In 1879 a Canadian engineer, Fleming, proposed the so-called time-zone system. According to this system, the surface of the globe is divided by meridians into 24 zones of 15^o width. Within each zone a standard time is established, called the zone time; this is taken as the local time of the central meridian of a given zone. When the border of the zone is crossed the clocks are advanced or retarded by exactly an hour depending upon which border is crossed: the eastern or the western border. Minutes and seconds in all zones are the same as those on the clock in the Greenwich observatory. Therefore Greenwich time is called international.

Time zones are numbered from west to east in the following order: zero, first, second, third, etc., up to and including the twenty-third. The center of the initial, i.e. the zero zone, is the zero (Greenwich) meridian; the center of the first zone is the meridian at longitude 15^o east; the center of the second zone is the meridian at longitude 30^o east, and so on through every 15^o of longitude.

In view of the fact that the distance of even the extreme points of the time zone from the central meridian does not exceed 7.5^o of longitude, the difference between the zonal and the local time does not exceed 30 minutes. Exceptions are the points at a greater distance from the central meridian due to irregularities in the borders

of the zone. The fact is that the borders of the time zones are laid strictly along the meridians only on oceans, deserts, and other uninhabited regions.

It is impossible to separate the time zones along the meridians in inhabited regions, since some oblasts [regions], rayons [districts], and even individual populated areas would be in different time zones with different time. For instance, Moscow lies on the border between the second and third zone. But what would happen if the western part of the city would be on the time of the second, and the eastern part on that of the third time zone, one hour ahead of the second zone? The inconvenience is obvious.

Therefore in inhabited regions the borders between the time zones are laid out, not along the standard meridians, but along the borders of the countries, republics, oblast's or along natural boundaries — rivers, seashores, etc. (See the time-zone map appended to the journal).

In our country standard time was introduced only after the Great October Revolution by decree of the Council of People's Commissars, 8 February 1919, and signed by V. I. Lenin. A total of 11 time zones were established in the territory of the USSR, from the second to the twelfth inclusive. The borders of the time zones were established in accordance with the administrative jurisdiction, therefore not only Moscow, but also the whole Moscow oblast', was put in the second time zone.

Almost all countries in the world operate on standard time. Thus England, France, Belgium, Holland, Spain, Portugal operate on the zero time zone, i.e. on Greenwich or universal time. Germany, Austria, Poland, Norway use the first time zone (it is called Middle-European time). In the USSR the time zones are called by the name of large cities or rivers.

From the time of establishment of the time zones in the Soviet Union, almost forty years have passed. In this time the economy has grown immeasurably; ties have been strengthened between the various republics, oblasts and rayons; administrative jurisdiction and administrative borders have changed. Therefore the former time-zone borders caused real inconvenience for a long time. In some oblasts — for instance Chitin oblast' — different times had to be used, since through these oblast's passed the standard meridians. One growing town, Novosibirsk, was divided by a time-zone border into two parts.

This is why the Interdepartmental Commission for Unified Time Service of the Committee of Standards, Measures, and Measuring Instruments attached to the Council of Ministers of the USSR passed a resolution to establish new time zones throughout the territory of the Soviet Union on 1 March, 1957.

According to this resolution, there are still 11 time zones. But their borders now fully correspond to the administrative borders. Exceptions are the Yakutsk ASSR, which is divided into three time zones instead of the former five, and the Krasnoyarsk region, divided into two parts instead of the former four.

Throughout the territory of the USSR on 1 March 1957, at 0 hours, 0 minutes, and 0 seconds, Moscow time, clocks were set so that their time was ahead of Moscow time by as many whole hours as the number of the time zone — in which a given region was located — differed from the number of the Moscow (second) time zone.

The map appended to the journal shows the new time-zone borders in the Soviet Union. In comparison with the previous zones, they have been changed rather considerably.[1] The railroad, telegraph, and all airways remain, as previously, on one time — namely, on Moscow time.

In addition to everything mentioned about time reckoning, it must be added that we have been living on a somewhat modified standard time since the summer of 1930. By decree of the Sovnarkom of the USSR, dated 16 June 1930, all clocks in our country were advanced by one hour. This time, advanced by an hour, is called decreed time.

This has been done to enable the population to utilize more fully the natural sunlight from spring to fall and to consume less fuel and electricity for artificial lighting. If one assumes that workers and employees usually get up at 7 o'clock in the morning and go to bed at 11 p. m., artificial lighting will be needed in the summer only during the night hours, from about 9 p. m., i. e. only for about 2 hours. But the decreed time has shifted the beginning and the end of the working day an hour ahead. As a result, during the summer, no artificial lighting is required in the morning, since dawn occurs long before people awake; and in the evening lighting is required not for two hours, but only for one. In the winter, since people get up and go to bed when it is dark, decreed time offers neither advantages nor disadvantages in the use of fuel and electricity.

All clocks in our country run on decreed time; hence the population in the second time zone lives on the time of the third time zone, as it were, and the difference between it and Greenwich time is 3 hours (the difference between the zero and the second time zone of 2 hours plus 1 hour of decreed time); in the third zone the population lives on the time of the fourth zone, in the fourth on the time of the fifth zone, and so on.

Standard time differs from local time in that the time in the eastern part of the zone is slow, in the western part it is fast as compared to local time; decreed time, on the other hand, is one hour ahead of local time in all time zones. For instance, standard time in Moscow lags 30 minutes and 17 seconds behind local time, while decreed time in Moscow is ahead by 29 minutes and 43 seconds. Hence noon is at 12:30 according to clocks of Muscovites.

Decreed time, just as any standard time, depends on its location on the globe. When it is 7 p. m. in the Chukotka district it is only 9 a. m. in Moscow; when it is noon here, it is midnight on the opposite side of the globe; when the population of Chukotka wakes up in the morning and gets ready for breakfast, Muscovites are eating supper on the day which for the Far East population was yesterday.

It seems that at the same moment different locations on the globe may have different dates. Where does the new day, the new month, the new year begin?

History knows many instances when people were embarrassed because they made a mistake in reckoning days. Such a mistake was made by the first expedition around the world by Magellan. In 1522, upon return to Spain from the voyage, the members of the expedition learned that they had returned on Friday, while according to their calculations it was Thursday. They carefully checked the entries in the ship's

1 Eight oblast's — Vladimir, Voronezh, Ivanovsk, Kostromsk, Lipetsk, Ryazan', Tambov and Yaroslav — have been transferred by decree of the Interdepartmental Commission for Unified Time Service from the second to the third time zone. But at their request these oblast's temporarily remain in the second time zone until a special decision is reached.

log; according to their data the day of arrival was Thursday. But the day was, in fact, Friday. For committing "a crime against religion", which consisted of observing the religious holidays not on appointed days, the members of the expedition were forced to do public penance.

Another interesting historical example. About two centuries ago, when Russian Cossacks crossed the Bering Strait and took possession of Alaska, they were very surprised by the fact that the local inhabitants observed Sunday one day later.

The cause of such discrepancies is very easily explained. Continuous change in the time of day on the globe occurs as a result of the apparent movement of the sun from east to west. Obviously, if one travels around the globe from east to west, i. e. in the direction opposite to that of the rotation of the earth, one makes one revolution less around the earth's axis. Therefore the Magellan expedition should have added one day to their calculations. If the globe is traversed from west to east, i. e. in the direction of its rotation, then, conversely, one day should be subtracted from calculations, since one extra revolution is added.

To avoid mistakes in reckoning days and to fix the position of the beginning and the end of the day, a date line was established by international agreement. This line runs mainly along the meridian at 180° longitude from the Greenwich meridian, touching land nowhere except in the Antarctic. It runs from the North geographic pole through the Bering Strait, then through the Pacific ocean, skirting numerous small Pacific islands and terminates at the South geographic pole.

The new calendar day, the new month, the new year always begin on the western side of the international date line.

The first to greet the new day, as well as the New Year, are the citizens of our country, the inhabitants of Chukotka; then the inhabitants of Kamchatka, Magadan, together with the inhabitants of Eastern Australia; then the Japanese, the inhabitants around Baikal, etc. For the inhabitants of Alaska, the new day and the New Year occur last.

In crossing the date line from east to west, one day should be dropped, and in crossing from west to east, the same day should be counted twice. If, for instance, an aircraft crosses the date line on 15 May from Alaska to Chukotka, the next day for it will not be 16 May, but 17 May; and if the aircraft flies on the same day from Chukotka to Alaska, the next day for it will be 15 May again.

The geographic poles of the earth and the adjoining land and water regions occupy a peculiar position. At the poles all meridians and time zones meet. At the poles there is only one direction, south or north. The North Pole, for instance, is surrounded everywhere by the south. If a house were built there, all its four sides would face south.

An explorer at one of the poles can pass from one time zone to another or over the date line several times a day; therefore the generally accepted rules of time reckoning are not acceptable to him. But it is necessary to live on some sort of time. One has to get up, eat, start and finish working, and go to bed — all at a certain time. Therefore a certain time is established there, for instance Moscow or Greenwich time, according to which all astronomical tables are computed.

Actually it is often necessary, while using daily one time standard, to resort occasionally to another time, especially in modern aircraft with its high speeds and long range of flight. Crossing several time zones in one flight is now an ordinary occurrence in aviation. Sometimes it is necessary to know the time in other countries. Everyone has undoubtedly read newspaper reports that the signing of some document or a meeting of statesmen took place at a certain date and at a certain hour, according to Washington, Middle-European, or some other time.

How can we equate it with our time?

The time at one point is easily determined from a given time at another point for the territory of our country: here one simply takes the difference in time zones which just yields the difference in hours. But calculations are considerably complicated when one deals with points abroad. Here our decreed time should be taken into account and one must determine whether one crosses the date line or not, and, if one does, in what direction: east to west or west to east. For instance, knowing the time in Moscow we would like to find the time in Fairbanks (Alaska). Moscow is in the second time zone, Fairbanks in the fourteenth. How do we determine whether the date line is crossed or not?

This can be calculated from formulas, but the simplest way is to refer to the table (See table), where the Moscow time is taken as the basis. All other time zones have their correction with respect to the Moscow (decreed) time.

To determine from this table the standard time of any locality — given the Moscow time — one must find on the map the number of the zone in which that point is. From the zone number the correction is determined and is algebraically added to the Moscow time.

Assume that we must find the time in London when the time in Moscow is 7 a.m. London is in the 0 time zone, the correction given by the table is -3 hours. The standard time in London is 7+ (-3) = 4 hours.

To find the Moscow time from the given time in some other time zone, the correction obtained from the table for this time zone must be algebraically subtracted from the standard time given.

Assume that we must find the Moscow time when the time in Chukotka is 18 hours. In the table for Chukotka time we find the correction, which is equal to +10 hours. The Moscow time will be: 18 - (+10) = 8 hours.

If the time in one zone has to be determined from the given time in another zone, the algebraic difference between the given and the required time is algebraically subtracted from the given zone time.

Assume that we must find the time in Chita at the moment when the time in Kamchatka is 10 hours. To solve this problem we find the difference in corrections. It is 9 - 6 = 3 hours. The time in Chita is 10 - 3 = 7 hours.

Another example. In Paris the time is 2 hours. What is the time at Irkutsk? The difference in corrections is -3 - (+5) = - 8 hours. The time in Irkutsk is 2 - (-8)= 10 hours.

If in the calculations the difference or the sum is greater than 24 hours, the 24 hours are subtracted from it and the date is advanced by one day; if the sum or the difference is negative, the date is shifted back by one day and the time is determined as the complement of this negative number to 24.

Let us solve the following problem. Find the time in Magadan, when the time in Moscow is 22 hours, September 25. From the table the correction for Magadan time is + 8 hours. Consequently, Magadan time will be 22 + 8 = 30; 30 - 24 = 6 hours, September 26.

Zone No.	Time designation		Correction in hours by ref. to Moscow time
0	Greenwich (International, West-European, London)		-3
1	Middle-European (Central European)		-2
2	Decreed standard:	Moscow	0
3	" "	Volga	+1
4	" "	Ural (Sverdlovsk)	+2
5	" "	West Siberian (Omsk)	+3
6	" "	Yenisey (Krasnoyarsk)	+4
7	" "	Irkutsk	+5
8	" "	Amur (Chita)	+6
9	" "	Maritime (Khabarovsk)	+7
10	" "	Okhotsk (Magadan)	+8
11	" "	Kamchatka	+9
12	" "	Chukotka (Anadyr)	+10
13	Standard:		-14
14	"	Fairbanks	-13
15	"	Yukon	-12
16	"	Pacific	-11
17	"	Mountain	-10
18	"	Central	- 9
19	"	Eastern (Washington)	- 8
20	"	Atlantic	- 7
21	"	"	- 6
22	"	"	- 5
23	"	Iceland	- 4

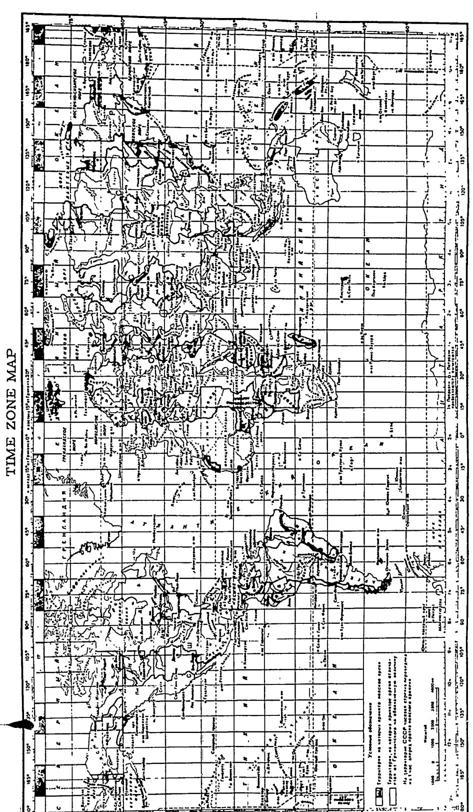
In view of the fact that we took into account the decreed time for the time zones passing through the USSR (from the second to twelfth), while there is no decreed time in other countries which use the same zone, in calculations, if the number of the zone of a foreign locality is two to twelve, the correction should be reduced by one. For instance, Tokyo is located in the ninth zone; therefore the correction should be taken not as +7 hours, as given in the table, but as +6.

In some countries in Western and Central Europe, as well as in the USA, the time is advanced by one hour from about April to September by the order of the government, and this time is called daylight saving time. In calculations this must be taken into account, and one hour must be added to the correction for the time zone of such a country. Such changes cannot be provided for in the table, since daylight saving time extends over different periods in different countries.

Time, one of the objective forms of existence of matter, is a rather important factor in man's life. Its reckoning and recording are irrevocably tied up with the creative endeavors of our society. New time-zone borders now completely meet the requirements of precise time reckoning, while a basic knowledge of this computation and the ability to compute time enable us to have a thorough understanding of it over the entire globe.

Military Navigator First Class,
Col. N. Ya. Kondrat'yev

TIME ZONE MAP



[The original folding map appended to the "Herald" measured 11.5 x 20.5". It was in color, scale 12 mm: 1000 km. In the legend box (lower left) territories which have adopted a standard time are shown white and dark gray. Territories in which the standard time differs by a definite value from Greenwich time are shown light gray. It is also noted that "In the territory of the USSR, the hour hand is advanced by one hour as compared to standard time." In the bottom margin (above the degree scale) the figures shown represent hours]

FROM THE HISTORY OF SOVIET AVIATION

TRANSARCTIC FLIGHT TO AMERICA

Hero of the Soviet Union, Lt. Gen. of the Air Force A. V. Belyakov

Twenty years ago, in June 1937, the crew of the well-known Soviet pilot, V. P. Chkalov, carried out the first non-stop flight from the USSR to America across the North Pole, in a Russian-made aircraft, the ANT-25. The crew left Shchelkovo Airfield near Moscow on 18 June at 0104 hours Greenwich Time and landed in the United States of America on 20 June at 1620 hours (also Greenwich Time). The aircraft remained in the air without landing for 63 hours and 16 minutes, i. e., for more than two and half days, and covered a route of 9130 km over the earth's surface. As for air distance, however, the route would amount to about 11,000 km. This difference in distance was "consumed" by a head wind, which decreased air speed by an average of 30 km/hr.

If we draw a line between the points of takeoff and landing along the shortest distance, i. e. along an arc of the great circle, then the orthodrome will measure 8583 km. The lengthening of the actual course by 547 km occurred as the result of its failure to coincide with the orthodrome in order to avoid cloud cover and because the aircraft reached the coastal area of the Pacific Ocean in Canada.

The crew was made up of three men: the crew commander, V. P. Chkalov; the copilot, G. F. Baydukov; and the navigator, A. V. Belyakov.

Shortly afterwards, on 12 July 1937, the Soviet pilots, M. M. Gromov, A. B. Yumashev, and S. A. Danilin, carried out a second transarctic flight to America across the North Pole. The Soviet aircraft, the ANT-25, flew a straight path, Moscow-North Pole-America, in 62 hours and 17 minutes, covering a distance of 10,148 km.

These long-range transarctic flights showed the whole world clearly our tremendous progress in aircraft construction, the great skill of our designers, and the remarkable virtues of Soviet pilots.

Nineteen hundred and thirty-seven was the first year of the third five-year plan for our country, a year of intensive work by the entire Soviet People on the path of further industrialization of the country. During the first five-year plan, an aviation industry was created in our country, and as a result aircraft appeared in the USSR which surpassed foreign models in quality. One such aircraft was the ANT-25, built in 1934 by a designer team headed by A. N. Tupolev.

This aircraft was designed for long non-stop flights. The high status of engineering development in this aircraft was manifested in a number of innovations and improvements. The ANT-25 was an all-metal monoplane with a wingspread of 34 m, which was quite unusual for a single-engined aircraft. The 13.1 wing aspect ratio and the exceptionally high aerodynamic characteristic of the profile selected gave the 11 ton aircraft, which had a single 1000 hp engine, the capability of taking off from a concrete runway.

In the flight to America, the weight of the aircraft at the start was 11,180 kg, of which 5800 constituted fuel (gasoline with a specific gravity of 0.73), 350 kg oil. Thus, fuel and oil constituted 55%, i. e. more than half of the gross weight of the aircraft. To facilitate design, part of the wing sections and the wing stump were converted into tanks. Consequently, the walls of the tanks served as power elements of the wing, which was a very rare phenomenon.

The ANT-25 was one of the first aircraft that had retractable landing gear and a metal three-blade variable-pitch propeller. The AM-34 engine was of the "low altitude" type, as a consequence of which the aircraft possessed a comparatively low "ceiling", not exceeding 6300 m.

During the first 10 hours of flight, true airspeed was maintained at an average of 185 km/hr at a flight altitude of 1000 m. Later, in accord with the gradual consumption of fuel, the weight of the aircraft kept decreasing, and this made it possible to fly at a high altitude; in order to achieve economy in fuel consumption, the engine rpm and airspeed were gradually decreased and by the end of the flight, at an altitude of about 3000 m, true airspeed did not exceed 150-160 km/hr.

Chkalov's crew pioneered the shortest air route for an aircraft flying from the USSR to America — that, in a nutshell, is the gist of the flight from Moscow to Vancouver. But is it true that the desired shortest route is located precisely in this direction? Two years later Pilot Kokkinaki flew from Moscow to New York. His route, 7450 km long on the orthodrome, lay across Iceland and joined the western part of the USSR with the eastern coast of the USA. But the shortest routes connecting the central parts of both countries as a rule cross the Arctic.

In 1937, our notions about the Arctic were rather meager. The northernmost polar station of the Glavsevmorput' [Main Northern Sea Route] was located in Franz Josef Land. Two months before our flight, a group of Soviet pilots, under the leadership of the prominent scientist, O. Yu. Shmidt, established the I. D. Papanin Station on the floe in the region of the geographic North Pole. But the area from the North Pole to the islands off the northern coast of Canada was a blank spot. The Papanin station regularly transmitted weather information over the radio, but that, of course, was absolutely insufficient for judging weather conditions throughout the entire central portion of the Arctic.

Our central weather bureau and the main aerometeorological station of the Air Force were the first to start setting up weather maps for the northern hemisphere, for only in this way was it possible to ascertain and anticipate weather change in the Arctic. Information was plotted on these maps as received from meteorological arctic stations of the USSR, Alaska, Northern Canada, and Greenland, and from stations of all the countries within 40° North Latitude.

In general the geophysical situation for a flight in June was favorable: it was the season of the arctic day, and by taking off early in the morning, the aircraft was able to fly for almost forty-eight hours in daylight. The first night should have found us in the sourthern part of Canada. Anticyclonic weather could not, naturally, accompany us throughout the entire tremendous route, and consequently we had to select periods with the least cyclonic activity. The first part of the route lay in a high pressure area. Beyond the North Pole we were met by an extensive anticyclone. En route we had to pass through two cyclone zones — in the Barents Sea and in Canada.

Inasmuch as the ceiling of the ANT-25 aircraft was not high, we had to fly blind in the clouds, risking the possibility of icing which represented the chief danger for us during the flight (only a fluid deicer had been installed on the aircraft for the propeller).

Great difficulties arose in maintaining communication with the ground. This problem was solved in the following way. On the aircraft there was a 20-watt crystal-controlled transmitter for several short-wave frequencies. The ground transmitting stations also operated on short waves, the selection of which depended on the distance. At a great distance, the operation was conducted on the 18 meter band. From Glavsevmorput' the services of two radio centers, five arctic rediffusion stations, and 14 arctic radio stations were enlisted to handle the flight. By agreement with the USA, radio stations in Anchorage (Alaska) and Seattle (USA) were enlisted for purposes of communication, as well as a number of receiver-transmitter points. All radiograms received from the aircraft were transmitted by ground radio and wire facilities to flight headquarters in Moscow, where they were checked, sorted, and the most reliable accepted as valid.

During this flight, one of the most difficult problems of air navigation was solved—flying across the Arctic close to the magnetic pole. For the first time the route was being established along an orthodrome: the first part was from the point of takeoff to the North Pole along the 38th meridian, East Longitude: and the second, from the North Pole along the 123rd meridian, West Longitude. To improve navigation in an area with a small horizontal component of the earth's magnetic field, the ANT-25 had a gyromagnetic compass, which was new for the time, the prototype of modern long-range gyromagnetic compasses of the DGMK type. This compass, together with a directional gyro, was the only facility for navigating the aircraft in the cloud cover. The gyromagnetic compass functioned satisfactorily almost up to the North Pole under conditions of undisturbed rectilinear flight. The inconvenience of navigating with it lay in the necessity of frequent recomputations of the magnetic course.

However a more reliable facility for air navigation in the Arctic was and still is astronavigation. It was used widely during this flight. For navigating on an orthodromic course, the ANT-25 aircraft had a solar course indicator (SUK), mounted in the navigator's compartment, which made it possible to determine the true course by the sun. To maintain this course, the pilot used either a directional gyro (correcting it periodically) or a special gnomon (sun clock) which was mounted on the engine cowling. Furthermore, for determining the line of position with reference to one celestial body or for determining the location of the aircraft by observation of two celestial bodies, the aircraft was equipped with a sextant, a chronometer, and tables of previously calculated altitudes and azimuths of the sun and the moon for points selected in advance. During the flight very frequent use was made of the solar course indicator which had been designed by Engineer L. P. Sergeyev and which served as the model for later astrocompasses of the equatorial type.

Desiring to avoid flying in the cloud cover as much as possible, Chkalov was compelled repeatedly to disturb the flight regime by making detours and altering the prescribed altitude. This of course entailed an over-consumption of fuel. When we landed after 63 hours of flight, 20 l of gasoline all told remained in the tanks, whereas if the "flight regime" had been observed, there should have been enough of it for more than 70 hours. The aircraft flew into the cloud cover five times, and of these, three instances were in the Arctic, all with varying degrees of icing.

For the greater part of the time, the flight was spent above the cloud cover which covered the earth, the water, and the ice surface. The sun's dazzling bright illumination of the clouds or of the boundless snow-covered ice, had a ruinous effect on our eyesight. All three of us worked with protective dark glasses. Protection of eyesight is indispensable for every crew flying in the Arctic in the daytime. Owing to the high degree of transparency of the air, the unprotected parts of our faces and necks were subjected to a deep tan and even to a light burn.

We turned towards the Pacific Ocean, after passing over Great Bear Lake. Before us was a heavy cloud cover lying on the mountains. After crossing the Rocky Mountains at an altitude of 6300 m, Chkalov dropped down below the cloud cover when we were over the ocean. Before us was the darkness of night, and behind us to the north, dawn continued all the while. On the morning of 20 June, we reached the shores of the USA in the region of the city of Seattle. Here we intercepted the air line route and used the American radio course beacons. We flew above the cloud cover at 3000 m.

While flying over the Columbia River, in order to check on our bearings, we dropped below the cloud cover, the ceiling of which was 300 m. We started to penetrate the overcast, but a warning light flashed from the supply fuel tank that there were only 60 l of fuel left. We returned to the Columbia River and landed at Vancouver Military Air Field in the state of Washington, at 0820 hours local time.

Our encounters with the American people began from the moment our Soviet aircraft touched down on American soil. We travelled through the United States by train from west to east, and spent some time in Washington, New York, and other cities. We were swamped with congratulatory telegrams and letters. Representatives of various strata of the American people wrote to us; but the majority of enthusiastic letters came from workers.

A number of official receptions and welcomes were arranged in honor of us Soviet pilots. I shall always remember how warmly we were welcomed by the population of the city of Portland. We walked down the main street with large wreaths of honor. Endless greetings echoed, and the entire route was strewn with flowers.

More than ten thousand people gathered at a meeting dedicated to greeting the Soviet pilots organized by the editorial staff of the periodical "Soviet Russia Today". When Chkalov mounted the rostrum, all rose to their feet and thunderous applause resounded. Someone started to sing the USSR Air Force March in English and thousands of voices joined in the singing.

We were greatly impressed by a meeting in New York in the huge building of the 71st Regiment. The top rows of seats were occupied by workers, whites and Negroes. From this "peanut gallery" loud cries of approval resounded during the entire meeting.

The American people warmly received us, the envoys of the Soviet Union, because we brought the friendship of our people to the United States.

Speaking at one of the meetings in New York, V. P. Chkalov said: "On the wings of our aircraft we have brought a greeting from one hundred and seventy millions of our people to the American people."

No less cordial was the reception accorded to the crew of M. M. Gromov which, during the same year, made the second non-stop flight to America across the North Pole.

Gromov was presented with a certificate as honorary citizen of the city of Los Angeles.

It is pleasant to recall these friendly encounters with representatives of the American people.

However, the ruling imperialist circles in the USA have exerted and continue to exert a great deal of effort in order to erase from the memory of simple Americans all that was good in the interrelations of the Soviet and American peoples, and to obstruct the development of normal friendly and cultural ties between both countries. But one would like to believe that the honest people of America will repudiate the calumny against the USSR being spread by the war-mongers, will not let themselves be intimidated, and will not permit the unleashing of an atomic war which can bring incalculable disasters upon all the peoples of the world.

THE EXPLOIT OF VALERIYA KHOMYAKOVA

On the dark gloomy night of 24 September 1942, Valeriya Khomyakova took off into the air with the element. Everything was quiet, it seemed. But suddenly in her headset she heard the commander's voice: "There are enemy Ju-88 planes in No. 6 quadrant at an altitude of 2000 m."

Valeriya started to follow the search lights closely as they played about the dark sky. But here, finally, she caught sight of the enemy, trapped by the intersecting searchlights as though gripped by pincers.

Sizing up the situation, the aviatrix took over the control stick, zoomed sharply upwards, and found herself over the enemy in an advantageous position. Soon afterwards she began trailing the enemy aircraft and she closed in on his tail. The enemy was caught in the crosshairs of the sight. After convincing herself that the aim was accurate, Valeriya let go with a long burst of machine-gun fire. A colored stream of tracer bullets, slashing the darkness of the night, pierced the fuselage of the enemy aircraft.

But the radio-operator gunner on the enemy aircraft returned her fire. Valeriya swerved sharply to the right and then boldly attacked a second time. Circling in from the right, she opened fire on the pilot's cockpit. The Fascist aircraft fell into a steep dive and plunged sharply to the ground.

Even now a report is preserved in the archives in which the following statement is made:

"On 24 September 1942, in the sky over the city of Saratov, in the area of the railroad bridge, Lt. Valeriya Khomyakova, aided by searchlights, made a second attack at an altitude of 2000 m and downed an enemy aircraft of the Ju-88 type in aerial combat.

"The aircraft fell 1 km south of the railroad bridge.

"By her heroic deed, Lt. Khomyakova made the first entry in the combat score of the 586th Fighter Air Regiment."

In the last months before the war I had occasion to work at the V. P. Chkalov Central Aeroclub of the USSR. Here, among other women pilots who were distinguished at the time, I met Valeriya Dmitriyevna Khomyakova, famous as an expert in advanced piloting on sport craft and as a participant in air shows.

Valeriya Khomyakova grew up in the family of a chemical engineer, where from childhood she became accustomed to work and to a feeling of respect for her comrades, for the team.

Valeriya entered the D. I. Mendeleyev Chemical and Technological Institute in Moscow. She combined her study in the Institute with training exercises in a glider group. This was her new passion. In 1937, upon being graduated from the Institute, she received the diploma of chemical engineer and also a certificate as a glider-pilot. A year later, Valeriya Khomyakova, now a chemical engineer in the Frunze plant, successfully completed training with the Aeroclub and remained in it in the capacity of pilot instructor, thereby binding her life forever to aviation.

War broke out. Many of Khomyakova's students went off to the front. An ardent patriot, Valeriya, too, longed to stand up for the defense of the Motherland with weapon in hand. In the fall of 1941, she was enrolled in the newly formed Women's Fighter Regiment, with the position of Deputy Squadron Commander.

A difficult period of retraining started, on the military fighter aircraft YaK-1. The regiment studied aerial combat theory intensively, combining it with daily practice work.

Major T. A. Kazarimova was appointed commander of the 586th Fighter Air Regiment and O. P. Kulikova, Military Commissar (see photo: T. A. Kazarimova, right, and O. P. Kulikova congratulate V. D. Khomyakova on her victory).

Valeriya gave all her energy, knowledge, and skill, in order to serve her Motherland honestly. While carrying out combat watch duty to guard a sector entrusted to their regiment, while making an intercept sortie, or while escorting aircraft, Valeriya was always ready for a skirmish with the enemy.

Valeriya was the first woman pilot to down an enemy aircraft in night aerial combat. By a decree of the Presidium of the Supreme Soviet of the USSR, she was awarded the Order of the Red Banner for manifest bravery and courage in carrying out a combat mission. The rank of "Senior Lieutenant" was conferred upon her, and she was appointed squadron commander.

Success did not turn her head; as before, she carried out her combat missions selflessly and skillfully. It is a pity that the life of such a wonderful person came to such an early end. Valeriya perished carrying out a combat mission while still full of vigor and a passionate desire to fight against the enemy until complete victory.

Senior Lieutenant of the Reserves, A. Ye. Tsapava

IN A SPECIAL ASSIGNMENT AIR DETACHMENT

B. N. Kudrin

In connection with drawing up measures for battle against the cavalry corps of White Guard General Mamontov, which had broken through to the rear of the troops of the Southern Front in the summer of 1919, V. I. Lenin pointed to the possibility of utilizing aircraft against the cavalry. For this purpose a special assignment air group was quickly formed, by order of the Revvoyensovet [Revolutionary War Council] of the Republic (the 41st and 51st Reconnaissance and the 8th Fighter Detachments, the "Il'ya Muromets" Airship Detachment, and a special assignment detachment made up of instructors from the Moscow School for Military Pilots).

Published below is a passage from the memoirs of Boris Nikolayevich Kudrin, former pilot of the special assignment detachment and later a test pilot.

One night in August, 1919, we instructors of the Moscow School for Military Pilots, living in one of the private residences in Petrovskiy Park, were awakened by the head of the school, Yu. A. Bratolyubov. He informed us that he had been summoned to Glavvozdukhoflot [Air Fleet Headquarters] and ordered to form a special assignment combat air detachment to fight General Mamontov's cavalry which had broken through to the rear of our troops.

In connection with the fact that the detachment had been assigned a mission of special importance, involving extremely dangerous combat flights, Bratolyubov had been given unlimited authority in the selection of personnel and equipment. "In accordance with the old combat tradition for carrying out particularly dangerous missions", said Bratolyubov, "volunteers are always called upon. Consequently if anyone of you feels that he isn't completely well or not strong enough and not confident of the fact that he will be able to give his life for the Revolution without the slightest hesitation; if anyone of you is not confident, not only of himself, but also of anyone of his comrades, then say so right now, frankly and honestly."

I shall not begin to describe the tremendous enthusiasm which gripped us. The slight feeling of mortification occasioned by the very possibility of doubting anyone of us, as indicated by the head of the school, was lost in a feeling of gratitude and joy at our awareness of the importance of the mission assigned us by V. I. Lenin, and of the confidence and honor which had been shown us.

It would be difficult to exaggerate the feeling of love and respect that we pilots felt for the head of our school. He was older, more experienced, and more intelligent than any of us. A former officer in the Tsarist army, he had already become famous during the imperialist war — though he was still flying only as an observer-pilot at the time — in one of the most famous air groups. Witty and gay, an inimitable raconteur, he possessed without doubt an innate artistic talent. In our school club, "Wings of the Commune", where famous musicians, singers, and actors of the Moscow theaters frequently appeared, Bratolyubov enjoyed no less success by his interpretation of comic characters from Chekhov. But the main thing is he was a bold, courageous pilot who had mastered the art of advanced piloting to perfection. At the Air Force celebration in 1918, he demonstrated amazing flying skill before all of Moscow. His "falling leaf" with autorotation, nose spin, and wheels-up spiral amazed everybody, and became part of the golden heritage of the art of Soviet piloting. Yu. A. Bratolyubov also left behind a literary monument of his flying skill, by writing what was to all intents and purposes the first Soviet guide for advanced piloting — "How I Perform Advanced Piloting Maneuvers".

I became acquainted with Bratolyubov in 1918, in the 14th Fighter Air Detachment, to which we were both assigned at almost the same time. Upon receiving new aircraft and testing them for advanced piloting, we shared our impressions. He said to me: "You do successive loops well, but, Boris Nikolayevich, they'll be so much better if you bring them down a little." I was greatly surprised by that. It seemed to me that I was doing them very low now (there was danger in this and, consequently, a sort of flying "dash"), but to my reply that in pulling out of a "dive", the ground was "under my very nose", he calmly answered: "It only seems like that to you; you've got a good 150 meters in reserve."

To tell the truth, I didn't believe him. But next day, noticing that he was flying at an even lower altitude than what he had advised me to do, I became imbued with the deepest respect for him.

Bratolyubov was soon appointed head of the Moscow School for Military Pilots. He proposed that I, too, transfer to the school with the position of head of the fighter section — as senior instructor for advanced piloting. And then once after one of his aerobatic flights, when one of my young students asked him how it was that he was not afraid to perform aerobatic maneuvers at such a low altitude, we heard the following answer from him: "But who told you that I'm not afraid? I am afraid. But I force myself not to be afraid. Keep in mind that a coward will cite any number of the most irrefutable arguments and proofs in justification of his cowardice. But a real man, even if he is afraid of something, must master his feelings and must do it without fail. At first it will be a bit frightening, but then it's nothing, you get used to it. But if you allow your cowardice to persuade you, even once, not to do what you can do, but are afraid, then you're a goner. You'll never be a real pilot".

It should not be assumed, however, that, because of some sort of mischievousness, Bratolyubov was urging us on to dare-deviltry and recklessness. Not at all. He would very shrewdly and thoroughly evaluate the potentialities of each pilot and would place demands upon him in accordance with his capacities. That's the kind of man Bratolyubov was, and our love, respect, and devotion to him were boundless. In Bratolyubov's steps, or upon orders from him, each of us was ready to rush anywhere and to carry out any task, even, it would seem, the most unfeasible.

After receiving our consent, Bratolyubov proposed that each pilot select an aircraft and a technical staff (mechanic and engine man). He then assigned duties among the pilots, for the formation of separate detachment outfits. I was also given the functions of train commandant.

Work was in full swing. Without pausing over the details of the formation, I shall say merely that an air detachment with eight aircraft and with its own facilities and technical supply was formed during a forty-eight hour period. From that moment on the railroad train became our primary "base on wheels".

We had not yet managed to leave Moscow, when Bratolyubov summoned me and warned me: "During the movement of the train, many obstacles will be encountered that will hamper its rapid advance. You must ensure speed of movement by all means. Don't let the train remain standing at the railroad stations". He warned me that he would be following my work and would evaluate it as though I were carrying out my first combat mission.

With the departure of the train from Moscow, a well-deserved rest ensued for all, since we had had hardly any sleep at all during the preceding two nights. But for me, as train commandant, the train's advance to its destination proved to be even more strenuous work. Any member of the post-revolutionary generation can hardly picture to himself the railroad traffic of that period. Transportation had been demolished: there was a shortage of locomotives, coaches, and fuel; the journal boxes were burning, and the locomotive mechanisms breaking down. Trains moved irregularly, without any schedules, stopped frequently en route, and no one knew when a train would go on. One should not be surprised, therefore, that, just as in the movies, one obstacle after another arose in our train's path. But I had been ordered to move it forward with every means at my disposal, and move it I did. However, in spite of all my efforts, we advanced very slowly, and it was only towards the end of the second night that the train approached its destination — the Zhdanka Station.

Dawn had started to break. I reported our arrival to Bratolyubov and I received the order to put our detachment on the alert. The unloading of aircraft began, and in a few hours we were already flying to the field airdrome.

From that moment on, in spite of the danger of being captured by the stray Cossack mounted patrols of Mamontov, our aircraft started to work from forward area fields or landing strips, far from our "base on wheels". The necessity for this and the risk involved were due to the performance capabilities of the aircraft which we were flying.

After we had flown over to the Politovo airfield and inspected and checked our aircraft and engines, preparing them for next day's work, the commander assembled everybody, explained the situation, which we plotted on our maps; then he assigned us a general mission: that of finding the main forces of Mamontov's corps, determining its numerical strength, its composition, and direction of march, and, after spotting it, not to lose sight of it for even a minute but to attack it incessantly as it marched or bivouacked.

Our aircraft took off at dawn the next day, but spotted nothing important. During subsequent flights, we began to run into stray mounted patrols and small cavalry detachments. Even though they did not solve the main problem, these encounters nevertheless gave us a good deal of experience.

I "stumbled upon" the first detachment that I encountered (it had a force of about 100 sabres) while flying at an altitude of 200-300 meters with a visibility of approximately 3 kilometers. Leaving the road, the cavalry-men rushed full gallop into the field towards a copse which could be seen not far away. In order not to lose them, in view of such limited visibility, I made a sharp vertical bank to the left, at high speed with a 180° turn, and, coming down, fired a long burst at them. The position for firing during such a maneuver proved to be very awkward. I don't think my fire caused any severe losses, but when, as I continued to fire, I approached the detachment to a distance of ten meters, an incredible picture appeared before my eyes: the panic-stricken horses were rearing up on their hind legs, throwing their riders, and were falling, crushing the cavalrymen. Everything was in a state of confusion. Both the men and the horses were seized with terror. Upon seeing this, I started to make steep vertical banks over the very ground, almost over the very heads of the riders. Here is where my aerobatics came in handy! I had to shoot only rarely but not a trace remained of the cavalry detachment. My fuel was giving out and I put an end to the "hunt". Taking a final glance at its results — men and horses lying on the ground and the individual riders rushing in various directions — I flew back "home".

What conclusion did I reach as a result of this flight? First of all, that not a single shot had been fired at me from a detachment numbering approximately 100 men (a Cossack sotnya). I knew nothing at the time about V.I. Lenin's words that cavalry is helpless against a low-flying aircraft. Through my personal experience, I became convinced that this was absolutely true. There remains for me only to add that approximately the same thing happened with Bratolyubov and Gerasimov.

Some time later we shifted our base to Yefremov, where we were able to utilize the race track as an airfield. We started to encounter individual cavalry detachments of the enemy more frequently and in greater strength and we bombed them from our fighters.

The point of my memoirs is to tell our youth, our young pilots, who now fly in such splendid aircraft, how selflessly pilots risked their lives to achieve even very modest results, impelled only by the single thought that it was necessary for the cause of the Revolution.

First of all the bombs which we employed at that time were ten-pound high-explosive bombs, and a single-place fighter could take on a maximum of only two such bombs. In order to drop the bomb, the pilot had to take it out of a bag, place it on his lap, and "unlock" it, i.e., by means of a screwdriver or pliers, bend back the forked locking plate which secured the arming vane of the firing pin.

The bomb had to be dropped with an unlocked, but not unscrewed, arming vane, for otherwise the explosion of the bomb might have occurred on the pilot's lap. The pilot was able to carry out all the operations for dropping the bomb over the side of the aircraft with one hand only, because his other hand was occupied with the controls, which, due to the instability of aircraft at that time, the pilot could not leave for even a second. And yet, more than once, covered with cold sweat, you nevertheless drop the controls and with the other hand you seize the arming vane which you have neglected during all these manipulations and which before your eyes is beginning to unscrew with violent speed. And after dropping the bombs and returning from the combat flight alive, you begin to speculate as to how many turns of the arming vane screw stood today between you and death.

In spite of the fact that dropping a bomb "by hand" from a single-place fighter was almost a heroic exploit for the pilot, what losses could he inflict upon the enemy? Kill a few horsemen galloping about in various directions, with a ten-pound high explosive bomb?

Fortunately, the enemy didn't have the slightest idea of our mishaps with the bombs and of their effectiveness. But the psychological and moral effect produced by

aircraft flying low and dropping bombs was tremendous and even more powerful than the fiercest bombardment from high altitudes. It was for good reason that in some places, instead of bombs being dropped from the aircraft, small and large cans with perforations were used, sowing panic among the enemies merely with their whistle and screech.

And now we regretted bitterly that we found ourselves in fighter aircraft. We had not been sent to the front to chase after stray detachments. We had to find Mamontov's main forces and smash them. The enemy had no air force and there was no one to fight with in the air. We needed aircraft for extensive reconnaissance, aircraft of a kind which could take a considerable supply of bombs on board for bombing.

This was completely feasible and Bratolyubov reached a decision swiftly. Informing Moscow that two-place reconnaissance aircraft of the "Sopwith" type should be made ready for us, our commander sent me to receive the first machine.

By the next day I was already back in Yefremov again, but in a "Sopwith" instead of my "Nieuport". Communist Kari, a student-pilot at our school, had been assigned to me as an observer. After me, Gerasimov carried out the same sort of operation, and communist and student-pilot Gorelov was assigned to him as an observer.

I still remember very well one of the flights that we made from Yefremov, because it was during this flight that I made my first landings on terrain which, according to reports, was occupied by the enemy.

During a flight by Andreyev, who was the commander of a fighter air detachment of our group, and who had taken off for a reconnaissance sortie, the motor failed. He made a forced landing and, leaving his aircraft, made his way back to our side without falling into the hands of the Cossacks. Next day, Truskov together with observer Blokhin, and I with observer Minin, while leaving to carry out a regular mission, received a supplementary one from Bratolyubov: to spot Andreyev's aircraft from the air, to determine if that area was occupied by the Cossacks, and also if they had occupied Yelets, in the vicinity of which all this was going on.

Flying in a pair, Truskov and I found the aircraft, carefully examined the entire terrain all around, but spotted no Whites. However, I wanted to make absolutely and exactly sure about this, and I started to land my aircraft not far from the village to which the aircraft had been dragged. Truskov decided that my motor was failing and that I had started to make a forced landing, and he started to land to come to my assistance. Jumping out of the machine, Minin questioned first some boys and then some peasants who had come out of the village. It turned out that Cossack detachments had actually been here but it was already about two or three days since they had left.

In exactly the same way, after landing once more near Yelets, I found out that it had already been abandoned by the White Cossacks two days since. Upon our return, we reported the situation to Bratolyubov. He at once dispatched from Yefremov a group armed with machine guns, under the command of Military Pilot A. A. Levin, and it was this group that brought Andreyev's aircraft to our airfield.

Our troops now started a swift forward movement. We flew over to Yelets, where Bratolyubov too arrived in a third "Sopwith" which had also been received from Moscow.

Scarcely had we joined our "base on wheels" again, when we had to fly still further south, to the small town of Kurbatovo in a district of the Voronezh-Kursk Railroad.

Before takeoff, Bratolyubov called us all together in the coach and said that we must change our sweep method. He proposed conducting reconnaissance with landings on enemy territory and interrogation of local inhabitants. Since this was a very dangerous mission, he considered it expedient to assign it to one aircraft for the time being; and as to precisely which pilot, that would be decided by lot. The lot fell to Gerasimov. I was very chagrined and envied him.

Then, drawing our attention to the fact that with the flight to Kurbatovo we were approaching the front line in real earnest, taking a map out of his map-case, he required us to transfer from it to our own maps the location of our units and those of the enemy. When this had been done, Bratolyubov said: "And now, comrades, I would like to find out your opinion about the following question. The decisive moment is approaching. We shall be attacking the spotted enemy columns together, with all our aircraft. If, during such an engagement, one of our aircraft becomes disabled and makes a forced landing, I feel that the other two aircraft must land with it and take the crew of the disabled craft on board their own. These aircraft must land under any conditions, not stopping at any risk whatsoever. I personally, independently of your answer, will always land with a plane that has been knocked down, for I cannot allow the enemy to capture anyone of you before my very eyes."

The danger that this proposal spelled for each of us was obvious. Landings would have to be made, not on an airfield, but on a completely fortuitous surface which the pilot would not even have time to reconnoiter from the air. Furthermore we were flying antiquated English aircraft dating back to the beginning of the imperialist war. There were many instances in our flying experience of motors stopping at idling speed during a landing. Consequently the danger of breaking the aircraft while landing on an unfamiliar surface could be aggravated still further by a simple stopping of the motor. However, since we had boundless faith in our commander we accepted his proposal unconditionally and gave each other our solemn word to land in order to assist each other under any conditions.

"But what's to be done, if not three, but two aircraft are flying", asked Gerasimov, "as happened, for example, with Kudrin and Truskov? In this case the aircraft which lands to give assistance can take only one man on board. Which of the two should it take?"

And here something took place which I cannot recall without emotion even now. The detachment commissar, Sergey Kurnikov, stood up and said that there could be no discussion here of any choice whatsoever, but there must be a firm decision made by the Communists. He said that the detachment pilots, who had sided with the Soviet Government and were defending it with weapons in hand, all experienced and skilled men, capable of training hundreds of young Communist pilots in the future, were of tremendous value to the state at the present time. Consequently there should be no doubts, no choice whatsoever: the aircraft which lands to help another must take the pilot on board. "I myself shall be flying with you as an observer", said the commissar, "and if I meet with an accident, I'll not let myself be caught by the Cossacks alive but I'll keep the last bullet in my revolver for myself". Both Minin, Bratolyubov's observer, and Kari, my observer, said the same thing. Deeply moved, Bratolyubov embraced and kissed each of us.

We flew to Kurbatovo and here circumstances shaped up in such a way that Gerasimov and I went out on reconnaissance in one of the aircraft, the former in the capacity of observer.

It was a calm day. Visibility was good. To obtain a better view, we climbed to an altitude of 600 meters, holding a southerly course. After flying for about 30 minutes and not spotting anything, I selected a place for landing. A flock of sheep, near which we noticed two shepherds, was grazing on a level field. There was no one around. After reconnoitering a landing area alongside the flock, I motioned with my hand to Gerasimov that I was landing. Smiling, he nodded his head at me approvingly. Scarcely had the aircraft stopped, when Gerasimov jumped out, grasped the aircraft by the wing and helped me turn it around in the opposite direction, so that in case of necessity we could take off immediately the way we came. Then, taking a carbine out of the aircraft, he headed towards the shepherds, while I remained in the plane, maintaining and regulating the operation of the engine at idling speed.

I saw Gerasimov approach the shepherds, holding the carbine in his hands. Then, after a short conversation, they started to point something out to him, and he studied his map. He soon returned and informed me that two days previously very many troops had passed through here with cannon and armored cars.

I took off and set my course in the direction indicated by Gerasimov. About 20 minutes more went by. We found nothing. Again we decided to land. A few women and children, who were walking towards a village which could be seen not far off, pointed out to us the direction in which the troops were moving. We flew still further to the southeast. Now everywhere we kept running into mounted patrols and rather large cavalry detachments. And again we had to land, but this time in a very dangerous situation. All around there were Cossacks, and we were landing almost within sight of them. Again we landed near a flock. I taxied up to the shepherds in order not to let Gerasimov go far away from the aircraft. This time, without saying even a word he jumped back into the aircraft and indicated the direction with his hand.

Not even 10 minutes had gone by since our takeoff, when we noticed a column of enemy transports stretching out over 5-6 kilometers, and ahead of them along the road moved an entire division, several thousand men in strength. These were White Guards Cossack units. Our mission had been fulfilled. Mamontov's large-scale troop concentrations had been spotted. We could go back.

After listening to our report and asking several questions which pinpointed the location of the enemy, Bratolyubov ordered Gerasimov to take off again with Gorelov as observer and to follow the movement of the enemy columns. Returning from their reconnaissance, Gerasimov and Gorelov brought even more valuable information: about 15 kilometers west of the place where we had left the enemy, they had spotted an even more important concentration of enemy troops. There remained no doubt whatsoever that Mamontov's corps was concentrated in this region.

After taking the maximum load of bombs on board, our three "Sopwiths" started off to bomb the enemy's large-scale forces. Before takeoff, Bratolyubov assembled all the pilots and observers and said: "We shall bomb the troops that we've spotted from an altitude of 800-900 meters". This was, of course, correct. Small-arms fire was ineffective at such an altitude, and we could drop our bombs safely on columns which were capable of producing powerful volley fire.

In about an hour we had drawn near the target. Bratolyubov pulled out ahead and led us over the very middle of the column; I noticed observer Minin drop the first bomb from Bratolyubov's aircraft. After it, our bombs too rained down thick and fast. Bratolyubov made a turn and took a return course. I followed after him. After swinging around, I noticed the results of our attack: all the bombs had blanketed the target. This was a real bomb strike on a concentration of enemy troops.

Upon our return to the airfield in Kurbatovo, Truskov's aircraft was grounded. During the bombing, his elevator control cable had been broken by an enemy bullet, but he had nevertheless flown safely as far as his airfield. Here, however, over the very airfield, the rod of his engine valve rocker arm broke and the cowling was sheared off. He made a safe landing but his aircraft proved to be totally useless. I, too, barely lasted till Kurbatovo with engine trouble and an oil tank which had begun to leak.

The takeoff for the next regular bombing of the enemy cavalry by our three "Sopwiths" had been scheduled for dawn. After the bombing, we were to fly directly to Yelets without landing in Kurbatovo. But matters did not work out that way. The mechanics worked all night on my aircraft without rest, but were not able to have it ready by dawn. In spite of my requests that they wait a while, Bratolyubov decided to go with Gerasimov and he ordered me to take off immediately as soon as my aircraft was ready and to drop my bombs alone. After their flight, Bratolyubov and Gerasimov were to land in Kurbatovo and wait for me, and then we would all fly to Yelets together.

Two hours went by. By my reckoning, it was already time for the two aircraft which had taken off to have returned, but they had not yet appeared.

My aircraft was finally ready and I took off. After approaching the enemy, Kari and I noticed that the enemy had moved considerably further to the west and had dispersed. Now he was no longer moving in a solid column along the road, but in separate detachments off the roads, in dispersed fashion. Kari led me to the largest concentration of enemy troops and we successfully dropped our bombs from an altitude of 900 meters.

I hurried back. I wanted to join Bratolyubov and Gerasimov as soon as possible. However, upon arriving in Kurbatovo, I did not see their aircraft. They had not returned even by nightfall.

Meanwhile the military situation in the region of Kurbatovo had taken a sharp turn for the worse, and we had to return to Yelets in a hurry.

We got to Yelets just in time. If we had been a day later, we would not have found our base in Yelets, for the kulak uprisings which had flared up in the Yelets district had necessitated it's being moved still further to the north, to Tula. There was no news at all about Bratolyubov and Gerasimov.

Before leaving Yelets, we decided to exchange our supply of matches, salt, kerosene, etc. for produce, making use of the few hours which remained before our departure. Having loaded all this in the detachment passenger car — a "Packard", Dellos the driver, Zaytsev the cook, and I left Yelets along the highway to Zadonsk.

About 10-12 kilometers from Yelets our car was fired upon and when we rushed back after turning around on the highway, we also met with fire by a large armed detachment. We found ourselves completely surrounded.

During the first minute, a brutal crowd of kulaks started to beat us unmercifully. They did not beat us to death only because their leaders decided to hand us over to Mamontov's men in order to "drag very important information out of us".

Driving us from one village to another and leading us further and further away from Yelets towards Zadonsk, they tortured us, beat us, and subjected us to brutal mockery and torture. At dawn on the third day, the village that we had been brought to the day before was surrounded and unexpectedly attacked by the Yelets detachment of Red Army men. As the battle was getting under way, I was led out to be shot. Taking advantage of the panic which had arisen in the village, I managed to hide and then to run over to the abandoned park of a landowner's estate near the barn which I had just been led out of. When the shooting in the village had stopped and the battle had moved further on towards the Don, I left my asylum in the park and, very cautiously, on all fours, made my way back to the barn, looked out from behind a corner and... saw a group of men headed by a sailor with a cartridge belt and a Mauser at his side. Our red stars gleamed on the service caps and the sailor caps ... This sailor, whom I knew well, was the commandant of Yelets.

My appearance was so unexpected that it frightened them, and some of them went for their weapons. "Friend! Friend!" I cried out, "L'vov, don't you really recognize me? I'm a pilot from your detachment, Kudrin!" But even after that, he didn't recognize me at once. However, his answer amazed me no less than my appearance amazed him. "Kudrin, is it really you? But we buried you in Yelets!"

It turned out that almost at the same time and at the same place my car was captured, the kulak bands had seized a truck going from Zadonsk to Yelets. On it were riding a group of pilots and mechanics with two machine guns. When they had been surrounded, they put up desperate resistance, but they were seized, killed and brutally disfigured. Evidently someone had taken me for one of the slain men. This was reported to the detachment, the Air Force group, and to Moscow, in Air Fleet Headquarters.

Informing L'vov that another comrade of ours was here, I rushed into the barn. Zaytsev was there, alive and conscious. In the panic that had arisen, the guard had abandoned him and fled.

Not having the strength to get up from the ground, he started to embrace the feet of the soldiers who had surrounded him. They picked him up and carried him out of the barn.

That same day Zaytsev and I were taken to Yelets, but we no longer found our detachment there. "On 30 September, the Special Moscow Detachment left Yelets for Tula", reads one of the archive documents. But the head of the Air Force group reported by direct wire: "The Moscow Detachment worked well but suffered great losses. Gerasimov and Bratolyubov, together with Minin and Gorelov, did not return from reconnaissance. Comrade Kudrin was shot near Yelets. Fire engine mechanics of the First Detachment and Military Pilots Satunin and Gurtyn' were shot together with him. The Moscow Detachment has been sent to Moscow ..."

I found my train in Tula on one of the tracks of the junction which was choked with trains. The news of my return spread instantly throughout the train, and almost the entire detachment gathered in and around the coach. Everyone wanted to embrace me or shake my hand; everyone wanted to see with his own eyes the "corpse that had returned from the dead". That same day, the head of the Air Force group reported to Aviadarm [Air Force C. in C.] by direct wire: "Military pilot Kudrin of the Moscow Detachment, together with Forager Zaytsev returned alive but badly beaten up."

That day, 4 October 1919, has remained in my memory as one of the happiest days of my life. However, I did not know then that this very day was the last one for Bratolyubov and Gerasimov. After my return, many began to hope that they would return just as I had. But they did not return. They perished. As was found out later, their death, according to the statements of Minin and Gorelov, who had survived at that time, took place under the following circumstances.

During the bombing of the cavalry, some stray bullet had managed somehow to hit Bratolyubov's aircraft and broken one of the engine valve control rods. This rod, loosened and dangling, hit the cowling and sheared it away, and the propeller broke into little bits. However, the aircraft still remained aloft and Bratolyubov did not lose control. All he could do in such a situation was to try to glide at the most advantageous angle as far as possible from the troops which he had just been bombing. And that's just what he did. And Gerasimov? That twenty-year old youth, faithful to the word we had given each other, did not falter, did not hesitate even for one instant. He did not abandon his comrade and commander, he did not fall even one step behind him. But from all sides the Cossacks rushed up at full gallop to these two descending aircraft. Bratolyubov landed safely. Almost at the same time, almost simultaneously but without selecting a landing area — for the question of a life was being decided in split seconds — Gerasimov started to land in order to take Bratolyubov on board. And he would have done it! His aircraft was almost coming to a stop next to Bratolyubov's, but at the very last moment one of his wheels hit a small rut. That was the end! The wheel was bent, broke, and the aircraft stopped. It could never take off again.

All four were captured; and on 4 October 1919, after being taken off to Khar'kov and jailed in the Khar'kov hard labor prison, Bratolyubov and Gerasimov were shot. Thus perished one of our glorious military pilots, a remarkable man, loyal to the cause of the Revolution, the intrepid Bratolyubov.

Soviet Russia is now reaching its fortieth year, I would like in this connection to call to mind the events and the men of the period who translated Lenin's ideas into reality and who gave their lives for that purpose. We know that they did not perish in vain, but that their memory lives on in our hearts, and their heroic spirit of friendship, staunchness, and selflessness lives on in the Soviet People.

THE ALL-RUSSIAN AVIATION COLLEGIUM

An all-Russian Collegium for the Administration of the Military Air Fleet of the RSFSR was formed by General Order No. 4 of the Army and Navy, dated 20 December, 1917 (published in the "The Army and Navy of Worker and Peasant Russia" gazette, No. 26, dated 21 December, 1917). The Collegium consisted of 9 men.

The Collegium was charged with the general direction of the activity of the Air Fleet, with the mustering and retention of Air Force detachments and equipment, and with the formation of Air Force units.

On 29 January, 1918, the All-Russian Collegium sent a telegram to all Air Force units, in which the suggestion was made that immediate consideration be given to the question of "an organized transfer of the Air Force into the ranks of the Workers and Peasants Red Army". It was suggested that the commanders of Air Force units and the soldier committees bring the Air Force detachments into combat readiness and train personnel and prepare equipment for imminent combat operations for defending the conquests of the October Revolution.

In the middle of March, 1918, the Collegium moved to Moscow, and in Petrograd a District Collegium was organized to administer the Air Fleet of the Petrograd district.

The intensification of military events necessitated a change in the forms of administration of the Air Force, and a shift from collegium administration to the establishment of a single command.

On 17 May, 1918, there was a conference in Moscow of representatives of the central and district Air Force administrations, of the combat Air Force units of the Air Force Council and the Aeronautical Council, on the reorganization of the higher Air Force agencies. The Conference subjected the Air Fleet Collegium to sharp criticism, pointing to the lack of correspondence between its work methods and the concrete situation of a civil war which was beginning.

By an order of the People's Commissariat for Military Affairs, dated 24 May 1918, the Chief Administration of the Workers and Peasants Red Military Air Fleet was established. At its head was placed a three-man Council: the Head of the Chief Administration and two Commissars. All of the functions of the All-Russian Collegium for the Administration of the Military Air Fleet, which was disbanded, were transferred to the Council.

In matters of administration, the Chief Administration was subordinate to the All-Russian General Staff, and in matters of supply, to the Chief Director of Supply.

Corresponding to this, in local areas as well, the district collegiums for administration of the Air Fleet were disbanded and in their stead, councils of the Moscow, Yaroslav, and other district administrations were formed.

FROM THE EDITOR'S MAIL

WE NEED A TECHNICIAN'S HANDBOOK

We have already grown accustomed to hearing a technician in the Air Force called an "aircraft boss". And this is quite justified. His duties include not only preflight servicing of the body and engine, but supervising the work of specialists of all the services: electricians, armorers, radiomen, etc.

Obviously, with the present level of development of aviation technology one man cannot possess universal knowledge. But, being the man who is directly responsible for the condition of the aircraft, the technician must know a great deal.

In his work, the aircraft technician comes across problems which he can solve only either in cooperation with comrades with more advanced training or with the aid of special literature. For instance, for technical operation of the aircraft he must know the types of fuel in use, lubricants, special liquids and gases, as well as the rate of their consumption.

To understand the phenomena involved in the operation of some assembly, to analyze the cause of its faulty operation, and to find the defect in the system from external symptoms — all require a knowledge of mechanics, physics, the basic theory of machine components and of mechanisms.

In our opinion, it is desirable to collect all of this information in a special handbook for the aircraft technician.

The handbook should be small in volume, convenient to use, and contain basic information on mathematics, physics, electricity, strength of materials, machine parts, mechanical drawing, aircraft materiology, fuels, oils, lubricants, special liquids and gases. It must contain the basic principles of aerodynamics and the essential data on maintenance.

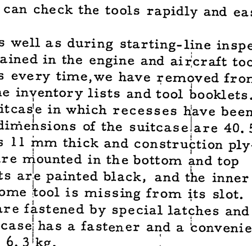
Such reference literature for engineers and technicians of different specialties is published by many houses. There are handbooks for construction engineers, railway engineers, repairmen, etc.

We, the aircraft technicians, need a similar handbook. This will not only make our work easier and broaden our knowledge, but will also augment our technical education.

Engineer Lt. V. Ya. Fishelev, Technician Lt. Yu. V. Skvortsov, Technician Lt. A. A. Zavrazhnyy

TIGHTENING CONTROL OF AIRCRAFT TOOLS

In the process of technical operation of aviation equipment, air engineering service specialists use dozens of different types of wrenches, screwdrivers, gadgets, etc. Let us take as an example the tools used by the aircraft technician on a fighter aircraft. Packed in two tool bags, the tools number over one hundred items. Different kinds of pockets, clasps and flaps in the tool bag are very inconvenient. Checking and packing the tools takes 50 minutes, and as a result the technical personnel never has the time to check them against inventory lists or tool booklets. Aircraft engineers and technicians take different precautions not to leave the tools in the aircraft after a job. One of these is to mark the tools, which enables us to increase the specialists' responsibility and to tighten control over the condition in which the workplace is left after work has been completed on the aircraft. This, no doubt, has definitely improved the situation, but has not solved the problem completely.



The solution, in our opinion, lies in creating conditions under which the aircraft specialist can check the tools rapidly and easily, without recourse to the inventory list.

During preflight and postflight servicing, as well as during starting-line inspections, the specialists do not use all the tools contained in the engine and aircraft tool bags. In order to avoid opening the aircraft bags every time, we have removed from them the needed tools and made notes of this in the inventory lists and tool booklets. The selected tools are packed in a special box-suitcase in which recesses have been made corresponding in shape to each tool. The dimensions of the suitcase are 40.5 x 29.5 x 9.5 cm (see Fig.). It is made of boards 11 mm thick and construction plywood. Inside the box, plywood inserts (panels) are mounted in the bottom and top with cutouts in the shape of the tools. The inserts are painted black, and the inner surface is painted red. It is very noticeable if some tool is missing from its slot. The inserts in the top and bottom of the suitcase are fastened by special latches and can be easily removed when necessary. The suitcase has a fastener and a convenient carrying handle. Its weight with a set of tools is 6.3 kg.

The tool boxes contain a list, which shows the designation, size, and nomenclature number from the tool booklet of the very bag from which the tool has been removed. This enables the technical personnel to make an easy check of all the tools charged out to an aircraft. The aircraft specialist spends no more than 2-3 minutes for packing the tools after the aircraft is ready and can make sure on the spot that they have indeed been removed from the aircraft.

In doing regulation, periodic, and other work, the aircraft specialists, in addition to the tool box, also open the engine and aircraft tool bags so as to have all the necessary tools and gadgets. Upon completion of the work, the technical personnel under the supervision of the flight technicians check the tools, check them against the list or tool booklet of the aircraft tool bags, and pack them in their appropriate places.

We had our boxes made by the specialists of the air maintenance shops, but it would be advisable to obtain them (of standard type) from the industry, together with aviation equipment and tool bags.

Of course, the use of tool boxes does not eliminate the necessity of checking the cockpit of the aircraft, the airducts in the fuselage, the nozzle fitting, etc, before flight; but it will make the control of the aircraft tools easier in many respects.

Engineer Col. B. M. Ravicher

I SOLVED . . .

SOLUTIONS TO PROBLEMS APPEARING IN ISSUES 1, 2, AND 4 OF THE PERIODICAL, 1957

HOW DOES THE ATTACK-LINE DISTANCE CHANGE ?

To solve the problem, let us derive the expression for the change in distance between the attack line and the object to be defended as a function of the change in the fighters' bank angle on the turn.

From the diagram (see the terms of the problem in "Herald of the Air Fleet", No. 1) it can be seen that the following equations hold for the simultaneous arrival of the fighters and the target at point A:

$$\frac{S_t}{V_t} = \frac{S_f}{V_f} ;$$

$$t_t = t_f ; \qquad (1)$$

$$S_f = CK + \smile CA ; \quad (2)$$

$$CK = S_{init} - S_t ;$$

$$\smile CA = \pi R.$$

Let us substitute in formula (2) the values of CK and $\smile CA$:

$$S_f = S_{init} - S_t + \pi R.$$

We substitute the value of S_f in formula (1):

$$\frac{S_t}{V_t} = \frac{S_{init} - S_t + \pi R}{V_f} ,$$

where

$$S_t = \frac{V_t}{V_f} (S_{init} - S_t + \pi R).$$

Let n equal the ratio $\frac{V_t}{V_f}$; then

$$S_t = nS_{init} - n\,S_t + n\pi R;$$

$$S_t + n\,S_t = n\,S_{init} + n\,\pi\,R;$$

$$S_t(1+n) = n\,(S_{init} + \pi\,R);$$

$$S_t = \frac{n}{1+n}\,(S_t + \pi\,R).$$

This equation allows us to compute the attack-line distance, i. e., the value S_t, and then S_c:

$$S_c = S_{init} - S_t$$

The turning radius is found from the relation:

$$R = \frac{V_f^{\,2}}{g \cdot \tan\beta}.$$

$\beta°$	S_c in Km
60	162
55	161
50	159,5
45	158
40	156,4
35	154,4
30	152
25	148
20	143
15	134
10	118

The values of S_c depend on the aircraft bank angle on the turn (see table).

The graph of the attack-line distance as a function of the bank angle of the fighters on the turn (see graph) is plotted for S_c.

Let us mark every 5° of bank along the y-axis at equal intervals, and let us plot along the x-axis the intervals (in kilometers) corresponding to ΔS for every 5° of change of the fighter bank angle on the turn.

The data obtained for the turning radius with a 60° bank corresponds to zero value on the graph.

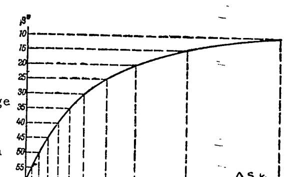
Thus for every bank (55, 50, 45°, etc.) ΔS is plotted along the x-axis, equal to the difference $S_{c60} - S_{c65} = 162 - 161 = 1$ km.

For a 50° bank $S_{c60} - S_{c50} = 162 - 159.5 = 2.5$ km, and so on.

Let us draw vertical lines through the end points of the intervals we obtained, to the point of intersection with the horizontal lines of the corresponding bank angles. The resulting points will be connected by a smooth curve.

It can be seen from the graph, that a 5° error in the bank angle of the fighter (with large bank angle on the turn) has no significant influence on the distance of the attack line. The same error with a small bank angle on the turn has a great influence on the distance of the attack line.

If the target must be attacked at a great distance from the defended object, the fighter must bank sharply.



Change in attack-line distance

The most advisable bank angle on turns under bad weather conditions and at night are banks of 30-45°.

A. M. Kostromin, V. I. Minchenko, K. L. Supon'ko, A. F. Khvorov, A. I. Ryadovskiy, G. Leymann, V. Leybiger, and others.

COMPUTE THE INTERCEPT MANEUVER

In solving the pursuit problem, let us find EF and the pursuit time from the point D:

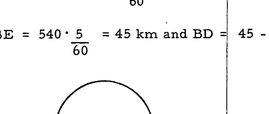
$$EF = \frac{540 \times 6}{720 - 540} = 18 \text{ km};$$

$$t_{purs} = \frac{24000 \text{ m}}{200 \text{ m/sec}} = 2 \text{ min.}$$

Thus the fighter will come out in a straight line at 15:30, i. e., the time spent in maneuvering is equal to 5 minutes. Hence

$$S_{man} = 720 \cdot \frac{5}{60} = 60 \text{ km.}$$

We find that $BE = 540 \cdot \frac{5}{60} = 45$ km and $BD = 45 - 6 = 39$ km.



Let us draw additional lines (see Fig.). From the triangle OO_1G the turn angle

$$UR = \arc\cos \frac{R + R \cdot \sin 20°}{2R} = 47°51';$$

Hence the arc

$$\smile NA = 70° - 47°51' = 22°9'.$$

Further, we can find the length of the circumference

$$S_{circ} = \frac{60 \text{ km} \cdot 360^\circ}{360^\circ - NA^\circ + ND^\circ} = 55.95 \text{ km}$$

and its radius is

$$R = \frac{55.95}{2\pi} = 8.9 \text{ km}.$$

This yields the bank angle on the turn:

$$\beta = \arc\tan \frac{V^2}{9.8\,R} = 24^\circ.6.$$

We find that

$$PD = OG = 2\,R \cdot \sin UR = 13.2 \text{ km}.$$
$$CA = 2\,R \cdot \cos 20^\circ = 16.7 \text{ km}.$$

Now we determine that

$$AD = PD - PA = 2\,R \cdot \sin UR - R \cdot \cos 20^\circ = 4.8 \text{ km}$$ and, furthermore, that

$$BC = BD - (CA + AD) = 39 - (16.7 + 4.8) \approx 17.5 \text{ km}.$$

G. A. Shustikov, A. F. Khvorov, L. A. Lushnichenko, N. I. Leleko, A. I. Ryadovskiy, E. N. Vladimirov, I. A. Zhorin.

WHAT WILL HAPPEN TO THE AIRCRAFT ?

In issue No. 2, 1957, the following problem was published: "What will happen to the aircraft if the wind velocity drops to zero suddenly when ground speed W equals zero?

The readers of the journal A. M. Kostromin, R. K. Belyayev, and others, have disagreed with the conclusion of the student. Officer O. D. Khlopotov believes that the student is right.

Let us give a detailed solution to this problem.

The established no-wind flight regime of the aircraft is characterized by equality of the thrust and drag, weight and lift. The conditions of flight with wind blowing horizontally at a constant velocity are the same, since the flight conditions are determined only by the motion of the aircraft with respect to the air medium. With a headwind the ground speed will equal the difference between the airspeed and the wind velocity. And the groundspeed equals zero, as the student reasoned correctly, if the airspeed and wind velocity vectors are equal.

The aircraft in this case "hangs motionless" because the flight takes place in the air medium which itself moves with respect to the surface of the earth with a velocity equal and opposite to the air velocity.

The disappearance of the wind means that the aircraft has come out of the area of moving air mass; its airspeed will change correspondingly and the established flight conditions will be disrupted. This will be followed by turbulence, in the course of which the aircraft will either return to the initial regime, or will enter a new regime — for instance, a nose spin. If, at the moment of cessation of the wind "motionless suspension" occurred, this means that as soon as the wind ceases, the lift and the drag will disappear: the aircraft will be subject to the forces of thrust and gravity.

Under the influence of gravity and thrust it will be accelerated: by the force of gravity, vertically downward; and by thrust, horizontally forward. If the airplane is longitudinally stable and does not tend to heel over, it will drop its nose and begin to pick up speed, rapidly losing altitude. The increase in speed will be accompanied by recovery of the lift, under the action of which the aircraft will begin moving on a curve, coming out of the dive under considerable acceleration force. Having described some undulating trajectory, it will return to horizontal flight with the initial speed and at the initial altitude. With a definite angle of attack and engine regime, the conditions for horizontal flight depend not only on flight speed, but also on air density.

If the velocity of the headwind is less than the airspeed, its disappearance will cause disruption of the flight regime and, in the process of turbulence, the aircraft will describe an undulating trajectory with loss of altitude and nosing down in the initial stage. When airspeed, after the disappearance of the wind, becomes less than that necessary for maneuvering, one should not go by the readings of the gyrohorizon and keep the aircraft from dropping its nose, since this may place the aircraft at the critical angle of attack. Even if the angle of attack does not reach the critical value, nevertheless an excessively large angle of attack hinders the recovery of speed.

The phenomena of disappearance or sudden increase of wind are encountered in flight — especially at high altitudes — in the vicinity of storm clouds and jet streams.

M. R. Fedorov

LOXODROMY AND ORTHODROMY

According to the statement of the problem, the difference in longitude is 180°, while $\phi_A = \phi_B$. Consequently, the loxodrome between A and B is a parallel; the orthodrome, on the other hand, will obviously pass through the north geographic pole (since it is an arc of a great circle and its plane must pass through points A, B and the earth's center).

The length of the loxodrome is

$$S_{lox} = \frac{2\,\pi R \cdot \cos\phi}{360^\circ} \cdot 180^\circ = \pi R \cdot \cos\phi,$$

and that of the orthodrome is

$$S_{orth} = \frac{2 \cdot \pi R}{360^\circ} \cdot 2(90 - \phi) = \frac{\pi R(90 - \phi)}{90^\circ}.$$

This yields the relative increase in the length of the loxodrome, equal to

$$\frac{\Delta S}{S_{orth}} = \frac{S_{lox} - S_{orth}}{S_{orth}} = \frac{S_{lox}}{S_{orth}} - 1 =$$

$$= \frac{\pi R \cdot \cos \phi}{\frac{\pi R(90^\circ - \phi)}{90^\circ}} - 1 = \frac{90^\circ \cdot \cos \phi^\circ}{90^\circ - \phi^\circ} - 1 .$$

Dividing the numerator and the denominator on the righthand side of the equation by 90°, we get:

$$\frac{\Delta S}{S_{orth}} = \frac{\cos \phi^\circ}{1 - \frac{\phi^\circ}{90^\circ}} - 1$$

and after substitution of $\phi^\circ = 70^\circ$ we get:

$$\frac{\Delta S}{S_{orth}} = \frac{\cos 70^\circ}{1 - \frac{70^\circ}{90^\circ}} - 1 \cong \frac{0.342}{1 - 0.78} \cong 0.55.$$

Thus, the loxodrome is 55% longer than the orthodrome.

L. M. Vorob'yev, A. V. Selivanov, A. I. Zelenov,
N. P. Sviridov

WHAT IS THE FLIGHT COMMANDER'S SOLUTION ?

After evaluating the existing situation, the flight commander decided not to engage the bombers in an aerial combat, but to attack the enemy's tanks and infantry to which the flight was revectored. In order to carry out this mission, he dropped down to 2000 m, since the enemy fighters were covering their bombers and could not attack our fighters. The first run on the target was made by the pilot from a dive parallel to the front line with a subsequent left turn towards his own territory, where he set up the maneuver for the next attack from the same direction.

Ye. I. Dement'yev

REVIEW AND PUBLICATIONS

OUR COUNTRY — THE BIRTHPLACE OF AVIATION AND AERONAUTICS

"Aeronautics and Aviation in Russia Prior to 1907." A collection of documents and materials. Oborongiz [State Publishing House of the Defense Ministry]. Moscow, 1956, 952 p. Price: 42 rubles, 65 kopeks.

The literature on the history of aeronautics and aviation in our country has been supplemented by a new book which represents a significant contribution to the elucidation of our people's struggle to conquer the air. In the published collection of documents and materials, entitled "Aeronautics and Aviation in Russia Prior to 1907", the documents describing the status of aviation and aeronautics in Russia before 1907 have been presented more extensively and thoroughly than in books published heretofore.

Both the archive documents (there are more than 700 of them) and the literary testimonies in the collection (some of the latter are being published for the first time) provide rich material for teachers in departments of military history and the history of technology, and for researchers and students in institutions of learning.

The collection opens with documents on the first attempts at flying in Russia which tell how Russians built the first flying contrivances in an attempt to ascend into the sky in them.

One's attention is attracted by a photocopy from the records of A. I. Sulakadzev, which attests to the fact that in 1731 Kryakutnoy, a Ryazan' scribe, made a balloon and rose into the air in it. This was the first ascent in history made by man in a balloon.

The years went by. In spite of the hostile attitude on the part of the authorities and the church towards attempts at constructing aeronautical appáratus, interest in them grew.

From the beginning of the 19th century foreign balloonists would, for the sake of profit, quite frequently arrange ascents and flights in balloons as novel attractions for entertaining the public in Petersburg and Moscow. In March 1804, the Russian Academy of Sciences, at the suggestion of Academician Lovits, decided to carry out a flight in a balloon for scientific purposes.

On 30 June 1804, Academician Ya. D. Zakharov, who replaced the ailing Lovits, together with the balloonist, Professor Robertson, carried out a flight in a balloon which lasted for 3 hours and 30 minutes. The balloon landed 60 versts from the place where it had taken off.

Very interesting historical documents have been placed in the collection, concerning the construction near Moscow of an aerostat which was supposed to be used in combat operations against Napoleon's troops who had invaded Russia. The great Russian general, M. I. Kutuzov, who knew about the construction of the aerostat, inquired in one of his letters to F. V. Rostopchin: "Please tell me if it will be possible to make use of it (the balloon. - Edit.), and how to put it to use most advantageously (p. 48)". The work of constructing the aerostat ended in failure, but many researchers both in Russia as well as abroad continued to work during the following years on solving the problem of utilizing a dirigible aerostat and aeronautical apparatus for military purposes.

Many Russian scientists and inventors displayed, in their work, a remarkable gift for scientific and technical foresight. Casting a daring glance into the future, many of them advanced bold ideas which only subsequent generations of scientists and inventors were successful in working out definitively and putting into actual practice, in view of a level of technology which had grown immeasurably in comparison with their time.

Patriotism and the ardent aspiration to bring benefit to the Motherland through their work characterized prominent Russian scientists. The documents on the work of the Russian inventor I. I. Treteskiy are interesting in that respect. All the works of I. I. Treteskiy are permeated with thought for the good of the Fatherland.

A special commission, which had examined the proposals of I. I. Treteskiy, observed that "for their novelty and for their many very cleverly devised methods" they "deserve special attention and detailed consideration" (p. 65).

In the first chapter of the collection, materials have been printed which deal with I. I. Treteskiy's invention and with projects for dirigible balloons by R. Chernosvitov and Ye. A. Vitgenshteyn, and with proposals by I. M. Matsnev and A. A. Sablukov for the utilization of balloons for military purposes.

The second chapter of the collection, dealing with documents that cover 1863 - 1890, is devoted to the events of an important period in the field of the history of aviation and aeronautics in the Fatherland. It was precisely at this time that the foundation of the age of aviation was laid through the invention, in Russia, of the first aircraft in the world.

In the second chapter, readers will find materials on the aerodynamic experiments of M. A. Rykachev, and a description of the works on aeronautics by the great Russian scientist, D. I. Mendeleyev. Excerpts have been published here from the work of M. A. Rykachev, "Initial Experiments on the Lift of a Propeller Rotating in the Air", and excerpts from his report "Historical Essay on Aeronautics During the Past Century", given at a conference of members of Russian technical, geographical, and physico-chemical societies. In this report, M. A. Rykachev cites the data of scientific observations made by him during a flight in a balloon 2 May 1873.

Along with other Russian scientists, D. I. Mendeleyev also concerned himself with problems of aeronautics. In the collection an excerpt is cited from the minutes of a meeting of the Physics Society of the University of Petersburg at which a report

by D. I. Mendeleyev was heard concerning an investigation of the upper layers of the atmosphere with a balloon having a hermetically sealed cabin. A letter to the chairman of the Commission on Aeronautics was also read.

In the second chapter there are many documents concerning the creative activity of A. F. Mozhayskiy, creator of the first aircraft in the world.

One of the documents gives an account of how a special commission — including Professor D. I. Mendeleyev; Lt. Gen. Zverev, member of the technical committee; professor at the Engineering Academy Col. Petrov; member of the Technical Committee of the Naval Ministry Col. Bogoslovskiy; and Struve, a military engineer — examined a project by A. F. Mozhayskiy and in its conclusion indicated "... the Commission find that Mr. Mozhayskiy has accepted as the basis of his project principles which are now acknowledged as the most reliable, and capable of leading to ultimately favorable results. In view of the important consequences expected from realization of the aeronautical project, and in view of the tremendous benefit that it can be to science and to the state in many respects, the Commission deems it useful to render assistance to Mr. Mozhayskiy for the continuation of his experiments on the model and parts making up his machine..." (p. 192).

In accordance with the decision of the Commission, A. F. Mozhayskiy set up a schedule of experiments with the models of his flying machine. The experiments with the models proceeded successfully. Information about A. F. Mozhayskiy's work soon started to penetrate into the press. The collection includes an article which appeared 10 June 1877 in the newspaper "St. Petersburg Gazette" concerning A. F. Mozhayskiy's work on an aircraft. Besides other information about the work of the inventor, the correspondent of the newspaper described a test run on the aircraft model, of which he was an eyewitness. "The test was carried out in my presence," he wrote, "in a large room on a small model which ran and flew about quite freely and landed very smoothly; the model kept flying even when a poniard was placed on it which presented a load of relatively great magnitude." (p. 198).

But naturally tests on models could not give the exhaustive data needed by the inventor. He decided to obtain these data by constructing a full-size aircraft and running tests on it. In a memorandum addressed to the Minister of War, A. F. Mozhayskiy points out that he".... has become convinced that it is necessary to change the method of conducting the research and that the data necessary for the solution of the problem can be obtained only on a machine of such dimensions that in it a man would be able to control the force and the direction of the contrivance" (p. 200). Attaching to his memorandum an estimate of the necessary expenditures, A. F. Mozhayskiy announced his decision to construct a full-size aircraft.

But Mozhayskiy's intention ran up against a solid wall of bureaucracy and incredulity on the part of the apparatus of tsarist officialdom towards the work of Russian inventors. A new Commission, headed by General G. E. Pauker, was formed to examine the inventor's work and to supervise it.

Documents included in the collection show how the tsarist officials, who were refined in chicanery, kept hampering the development of A. F. Mozhayskiy's invention. The inventor's protests against the ignorant and unjust conclusions of the Pauker Commission, his requests for the grant of necessary funds for continuing the project, remained unanswered, and Mozhayskiy had to build the aircraft mainly at his own expense. In spite of the obstacles placed in his way, he persistently continued working on his invention. On 4 June 1880 he applied to the Department of Commerce and Manufacturing requesting the issuance of a five year license for his aircraft. In the collection the full text of the license, issued on 3 November 1881, is cited and a sketch of the aircraft attached to it is also given.

The progressive elements in Russian society of the time followed with unabated interest the course of the work on the creation of the first aircraft in the world. This is attested to by newspaper and periodical articles devoted to Mozhayskiy's invention.

The documents cited in the collection make it possible to understand also how the Commission, under the chairmanship of General G.E. Pauker, upon examination of Mozhayskiy's proposal, tried to discredit his machine, and, by references to foreign "authorities", to prove the impracticability of a Russian inventor's carrying out the idea of creating a flying contrivance heavier than air. The negative conclusion of this Commission was then stubbornly repeated in official documents even when it was no longer possible to pass over in silence the fact that A.F. Mozhayskiy had built the aircraft and begun tests on it. In this connection, A.F. Mozhayskiy wrote:"All these opinions (the conclusions of the Pauker Commission - Edit.), which prove utter lack of familiarity with the really practical present-day state of technology, tend, as I can conclude, to kill in me at one blow confidence in the feasibility of my project...

"The situation in which I have been placed — the facts of which I can prove — cannot encourage a man in the path of intellectual work on behalf of his Fatherland, nor serve as an encouraging example for other Russians. On the other hand, dependence for inventions on foreigners has proved to be not completely favorable for us..." (pp. 214, 217).

In the collection there is also source-literature testifying to the construction and tests of A.F. Mozhayskiy's aircraft. However, contradictions are encountered in them in the indication of the date on which the construction of the machine was completed and on which the tests run on it began. The original archive documents cited in the collection (documents Nr. 169, 187, 199) and also the source-literature (documents Nr. 233, 347, and others) patently confirm the fact that the aircraft was completed and tests begun in 1882. Marking the services of A.F. Mozhayskiy in the development of aviation science and technology, the Soviet Government decided in March 1955, in connection with the 130th anniversary of his birth, to set up a bronze bust of Aleksandr Fedorovich Mozhayskiy in Krasnoye Selo near Leningrad, where, in the summer of 1882, the first aircraft in the world was constructed and tests on it were begun, during which the machine rose into the air.

In the collection there are a number of documents which discuss the inventor's continued work on his aircraft and the tests that he ran on it during subsequent years. Mozhayskiy constructed the aircraft at his own expense, against a background of utter indifference to his inventive activity on the part of the official-bureaucratic apparatus of the tsarist government. This apparatus not only did not help the inventor but in a number of instances hindered successful continuation of the work. After the inventor's death, work on the aircraft he had created ceased.

In tsarist Russia, no recognition was given to the project for a flying rocket machine developed by N.I. Kibal'chich, a student and member of "The Will of the People" who was imprisoned in the Peter and Paul Fortress by the tsarist government for participation in the assassination of Tsar Aleksandr II. The principle underlying N.I. Kibal'chich's project was the idea of propelling a flying machine by using the force of

reaction of the gas exhaust formed by the combustion of small regulated explosive charges.

Numerous proposals for the utilization of balloons for military purposes, work in this field in the armies of foreign states, compelled the War Ministry of tsarist Russia to set about organizing more resolutely aeronautics in the Russian Army.

On 5 December 1869, the Minister of War, D.A. Milyutin, received a memorandum on the necessity of forming a special commission to consider questions on the utilization of aeronautics for military purposes. Such a commission actually was organized under the chairmanship of General E.I. Totleben. In 1884 a commission was formed, under the chairmanship of General M.M. Boreskov, for the utilization of aeronautics, carrier pigeon mail, and guard towers for military purposes. It was made up of representatives of the Engineer Corps, the General Staff, and the Artillery. In 1885, a regular army command of aeronauts was formed, renamed in April 1887 as the Regular Army Aeronautical Training Pool. Documents are presented in the collection concerning experimental ascents of balloons; the flight of Lieutenants Kovan'ko and Trofimov in a balloon from Petersburg to Novgorod; the participation of military balloonists in military maneuvers; work on the creation of photographic apparatus especially intended for taking aerial photos; and also plans for the regulations and the staffs of aeronautical pools.

The third chapter of the collection sheds light on the period from 1890-1903. After prolonged discussions and correspondence lasting for more than three years, the War Department finally decided to ratify the Statute for an aeronautical unit and to set up an aeronautical training pool as well as aeronautical detachments assigned to fortress areas. In the "Statute for an Aeronautical Unit" confirmed 27 April 1890, its missions and personnel were defined as follows:

"1. The Aeronautical Unit has as its purpose the study and application to military requirements of discoveries and inventions in the field of aeronautics.

"2. All the installations of the Aeronautical Unit belong to the engineer troops.

"3. The Aeronautical Unit consists of: a) an aeronautical training pool; b) fortress area aeronautical detachments formed in peacetime..; and c) field aeronautical detachments formed in wartime" (p. 456).

In the Statute the aims of the Aeronautical Training Pool were also outlined. They amounted to the theoretical and practical training of officers and soldiers for aeronautical service, for carrying out experiments and testing the discoveries and inventions in the field of aeronautics, for the servicing and storage of materiel of the aeronautical detachments, and for the formation during wartime of field aeronautical detachments and the replacement of their personnel and materiel.

In the section of the Statute "Concerning the Fortress Area Aeronautical Detachments", it was observed that they "belong to the personnel of the military establishments, directly intended for the combat requirements of the fortress area. By means of these units, reconnaissance of the fortress area is conduc[illegible] during wartime and in case of necessity free flights are carried out from the fo[illegible]s area" (p. 458).

In August 1890, the Aeronautical Training Pool too[illegible]rt in the large-scale Narva-Krasnoye Selo maneuvers, during which [illegible] conducted observation of the "enemy" troops and carried out a free fl[illegible] in a [illegible]. In the collection a considerable number of documents has be[illegible]sented conc[illegible]g all possible kinds of experiments carried out in the Ar[illegible]h balloons and c[illegible]rning the participation of the aeronauts in military maneuvers.

It must be observed that Russian military aeronauts rendered great assistance in carrying out scientific research and observations. This is attested to, for example, by, among other documents, the "Considerations concerning the participation of military aeronautical units in an international scientific undertaking for research into atmospheric currents", composed by Lt. Gen. Boreskov.

Many documents of the collection are devoted to the fruitful activity of Russian scientists who made a truly invaluable contribution to the development of aviation science. Here is the letter of K. E. Tsiolkovskiy, dated 23 September 1890, which he sent to the Russian Technical Society together with his work "On the possibility of constructing a metal aerostat, capable of changing its volume and even of being folded flat.." The scientist asked that a small sum of money be allotted him for construction of a model of the metal aerostat, but Department 7 of the Society refused to grant him a subsidy on the absurd grounds that "in Europe and in America several attempts have been made to construct metal aerostats, which have led to no results whatsoever" (p. 476).

K. E. Tsiolkovskiy's attempts to gain recognition for his brilliant inventions and research from official persons and state institutions of tsarist Russia were futile. The projects and works which he presented for a decision, as well as the work of many Russian inventors, kept meeting with an unsympathetic, at times even outright hostile, attitude in all kinds of committees and sections of the state institutions of tsarist Russia. Frequently ignorant decisions were made regarding the work of the brilliant scientist: the critique of his research amounted in a number of instances to petty faultfinding.

In connection with one such decision concerning a project for an iron dirigible aerostat, K. E. Tsiolkovskiy wrote: "With what then has the greatly esteemed Department 7 of the Technical Society reproached me? In the first place, with incompleteness; this reproach is just, but everything cannot be done at once; give me time. Even when this work is published, I will not dare to consider my work as being either perfect or complete. In the second place, as for an insufficient familiarity with the pertinent literature, with this I readily agree; but I would like to know to what errors this lack of familiarity has led me, what conclusions of mine are incorrect because of it? I may have incorrect premises (the basic formulas of air resistance, the data on the strength of materials, on wind velocity, etc.), perhaps my analysis is wrong, and there may be simple errors in arithmetical operations.

"But the members of Department 7 have not deigned to point out even one such error to me."

The brilliant work of the renowned Russian scientist received every kind of support and general recognition only with the advent of the Soviet Government.

In Chapter 3, as in the preceding ones, there are documents concerning the most interesting projects for flying machines.

A considerable part of the materials of Chapter 4 of the collection deals with participation by aeronautical units of the Russian Army in the Russo-Japanese War of 1904-1905. In 1904, aeronautical companies of the Russian Army in the Far East were deployed in field aeronautical battalions of two-company strength. The first experiments by the Russian Army to use balloons in combat during the war yielded positive results. Maj. Gen. Myaskovskiy, the deputy to the chief inspector of the engineering unit assigned to the Commander-in-Chief, reports in a letter that "the activity of the balloons was so gratifying that now not only the headquarters of all three armies, but also corps headquarters, are begging us to send them balloons".

On the basis of the experimental participation of aeronauts in combat operations, special instructions were worked out for the utilization of aeronautical units among field troops. These instructions provided for the utilization under field conditions only of captive and signal balloons. The function of the captive balloons was reconnaissance from the air of the forward area of the location of defense points, of artificial obstacles, of approach roads to the enemy rear positions, observation of the movement and concentration both of our own as well as of enemy troops, and of artillery spotting.

In the collection, war diary excerpts have been reproduced concerning military operations of the Siberian Aeronautical Company, of the First and Second East Siberian Field Aeronautical Battalions, an account of the activity of the First Company of the First East Siberian Field Aeronautical Battalion, and other documents containing detailed data about the participation of aeronautical units in combat operations.

In December 1907 — the year of D. I. Mendeleyev's death — the first Mendeleyev Congress on general and applied chemistry took place in Petersburg. The following items have been included in the collection: a speech of N. Ye. Zhukovskiy at a grand meeting of this congress, "concerning the work of Dmitriy Ivanovich Mendeleyev on the resistance of liquids and on aeronautics"; excerpts from the speech of Professor A. I. Voyeykov on the work of D. I. Mendeleyev in meteorology; and excerpts from the article by Ye. S. Fedorov, the chairman of Department 7 of the Russian Technical Society, on the contributions of D. I. Mendeleyev to the field of aeronautics.

The materials of the collection testify convincingly to the fact that our country is the birthplace of aeronautics and aviation, that Russian inventors, scientists, and designers, made a valuable contribution to the history of aeronautics and aviation, and laid the first foundations for modern aviation science.

The compilers, N. I. Shaurov and M. A. Sidorov, the Institute for the History of Natural Science and Technology of the Academy of Sciences of the USSR, the Central State Archives of the USSR for Military History, and the State Publishing House for the Defense Industry, have performed an important and necessary service in preparing this collection for printing and in publishing it. This collection is the first systematic publication of documents on the history of the Air Fleet of the Fatherland, on aeronautical and aviation technology, and on basic thinking in science and design.

Our researchers, archives, and scientific organizations are faced with an urgent task of tremendous importance — to continue the publication of archive documents on the history of aviation in our Fatherland. These collections of documents must be issued in considerably larger quantities. Incidentally, the edition of the collection entitled "Aeronautics and Aviation in Russia Prior to 1907" (1750 copies) is very small and in no way whatsoever does it meet the demand of our readers for literature on the history of aviation.

The entire Soviet People is now preparing for the celebration of the 40th Anniversary of the Great October Socialist Revolution. The 40th Anniversary of the Soviet Army and Navy is drawing near. It would be gratifying, if by these historical dates, the Central State Archives of the Red Army were to publish collections of documents on the formation of the Red Air Fleet and its combat operations during the years of the

Civil War and on the development of Soviet aviation during the period between the two wars. The publication of such books would be an important contribution to the literature of the history of aviation, and would broaden the opportunities for studying the rich heroic past of our Air Force.

120 THOUSAND KILOMETERS ON THE AIRCRAFT TU-104

Military Pilot First Class Lt. Col. A. K. Starikov

2. THE FLIGHT TO ENGLAND

In March of last year our crew was assigned a very important mission: to carry out a flight to London. At that time preparations were being made for the forthcoming visit of N. S. Khrushchev and N. A. Bulganin to England, and the honor of carrying out several preparatory tasks connected with this historic event fell to the lot of our outfit. However, in addition to these circumstances, our flight had several other special features as well. With regard to these, our unit commander put it well when he said: "You'll carry the glory of new Russia to England". The commander was not exaggerating. At that time, not a single country in the world, including America, had jet passenger aircraft. Such aircraft presented a technical problem, on the solution of which many aviation designers had been working persistently. We were to carry out the first flight on an international route in a jet passenger aircraft designed and manufactured in our Fatherland.

The route lay over the cities of Vilnius, Berlin, Osnabrueck, Amsterdam, and the Strait of Dover. A favorable aspect of the route was the fact that it crossed thickly settled areas, large cities with modern airfields. The large number of homing radio facilities and typical radar check points facilitated air navigation under any weather conditions. We were to make the approach to London from the side of the mouth of the Thames — the place where the river disembogues into the North Sea.

Incidentally I cannot help but make mention of the exceptional persistence and diligence with which all the members of our crew prepared for the flight to London. With the help of topographers the necessary maps were selected. The homing facilities and radar check points along the route were mastered. A particularly painstaking study was made of the London Airport, its location, the length of its runways, and their direction. We did not fail to give our attention to the question of alternate airfields as well.

The day for the takeoff arrived — 22 March 1956. It's 1130 hours. The crew are in their places. The turbines are running evenly and almost soundlessly. Through the windows of the cockpit we glimpse those who are seeing us off. Among them are service comrades, commanders, chiefs. They are no less excited than we are. Mentally I can picture how they will all be following our flight. And this comradely participation, this feeling of team spirit, inherent in the Soviet people, gives us new strength, energy, and confidence in the success of the forthcoming mission.

At 1135 the aircraft lifts off from the runway. We gain altitude en route. This method for gaining altitude is advantageous for our aircraft, as indeed it is for all jet craft. The faster the craft reaches the prescribed altitude (level) the more fuel will be saved.

For a moment the sun broke through openings in the storm clouds; I glanced down and, against a background of snowy fields, I caught sight of the cigar-shaped silhouette of our aircraft. "In a craft like this" — the thought occurred to me involuntarily — "we don't have to be ashamed of flying even over London".

With the gain in altitude, the clouds become thicker and blacker. Both turbo-jet engines run steadily and evenly. Together with Co-pilot N. Yakovlev, I select the most advantageous climbing regime. The thrust reserve is very great. While still in the process of levelling off, we switch the turbines to a rated number of rpm and are now satisfied that a highter rate is not needed for gaining altitude.

At an altitude of 4000 meters, we switch on the autopilot. I look at the instrument — the altitude is increasing with exceptional speed. We reached the prescribed altitude — that is, 10,000 meters — at the moment when the Rzhev-Vyaz'ma Railroad lay beneath the aircraft.

Strong turbulence set in. From previous flights we know that this is the first evidence that the aircraft has entered the tropopause. One gets the impression that in this region the troposphere and the stratosphere are carrying on ceaseless warfare. Currents of air collide here with tremendous force. Invisible anabatic and catabatic currents of air clash, creating chaotic winds. No matter how large and powerful it may be, an aircraft is tossed about from side to side. We always try to pass this comparatively small layer of air as quickly as possible. A few minutes of flying and we again find ourselves in an environment of a calm air mass. The aircraft seems to be hanging motionless in space. Actually it is flying with ever-increasing speed. And the higher the altitude and the calmer and more rarefied the air, the less fuel the engines consume.

A. K. Starikov at the controls

Our radioman, Nikolay Belyayev reports to the dispatcher of the Moscow RDS [air traffic control] that we have reached an altitude of 10,500 meters and are flying at a speed of 800 kilometers per hour.

Having leveled off, we select a cruising regime, trim the aircraft by means of the trim tabs, and again cut in the autopilot — which we had had to switch off during the flight through the tropopause. A perfectly reliable apparatus takes over the operation for us. The autopilot is equipped with a powerful gyroscope which reacts sensitively to the slightest deviations on the part of the aircraft and which, by means of servo-motors connected to the rudders, makes the necessary corrections. The fuel system too is controlled automatically. Special mechanisms monitor the consumption of fuel and, at necessary moments, switch the feeding of the engines from one group of tanks to another.

Beyond Vilnius the weather began to deteriorate sharply. A strong head- and crosswind rose. We lost groundspeed. There was danger that we would deviate from our course. Navigator Ivan Kirillovich Bagrich measured the angle of drift and gave us a course correction.

The layer of clouds becomes even denser. We put to full use the excellent electronic facilities for air navigation which are at our disposal. Now and then we hear the reports of the navigator: "Gdan'sk on the beam", "Approaching Berlin", "I've tuned in on the Amsterdam homing station".

The swiftness of the flight excited every passenger and crew member. Owing to the thickness of the clouds, the cities over which we were flying could not be seen, but mentally we pictured to ourselves how entire regions and even states were being left behind. While we were flying over Western Germany, Nikolay Belyayev unexpectedly established contact with a radio operator in Brussels. The latter started to transmit in Russian the weather conditions in Brussels, Amsterdam, Paris, and London. Upon signing off, he said: "Happy journey dear friends!" This episode was very pleasant and touching for us. The friendly participation by the unknown man — a citizen of a country which we had never been in and about which we know but little — raised our morale which was good in any case.

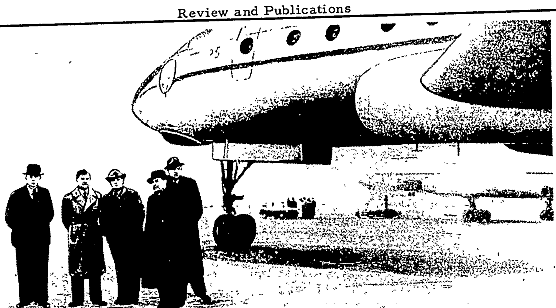
The closer we got to the shores of Great Britain, the worse became the weather and the more difficult it became to orient ourselves. Our fears were being confirmed that we would run afoul of unexpected "caprices" of the weather over the expanse of the North Sea and that we would experience strong winds and air currents. Meanwhile we maintained a very high speed and did everything possible to maintain it. Under these adverse conditions our navigator had to work very hard. He made computations and gave course and speed corrections with exceptional dispatch and exactness. Hardly would Ivan Kirillovich manage to tune the radio compass to one radio homing station, when he had to switch over to another.

I did not keep any records of the weather — there was no time for that — but I did observe attentively all its changes en route and tried as much as possible to keep everything in mind. I was especially interested in the winds and currents of air masses. I noticed that on our route, at an altitude of 10 - 11 thousand meters, the winds, just like ocean currents, also blow from west to east. They blow constantly, directly head-on, with a speed of 150 - 160 kilometers per hour. Here and there streams of cross currents are encountered; but as we found out in subsequent flights, they are not constant with respect to speed, although, to all intents and purposes, they are constant with respect to direction.

The third hour of flight was drawing to an end. According to our calculations, the shores of Great Britain should appear soon. The clouds thinned out and we vigilantly peered into the distance.

"England ahead!" reported the co-pilot spotting a thin strip of land before the others did. At the same time large gaps appeared in the clouds and we caught sight of the sparkling waters of the Strait of Dover. Directly in front of us lay North Foreland. But now the clouds closed in on the aircraft again and a familiar gray mass crept by the windows. We are now maintaining contact with the London RDS. It authorized us to descend to the Epsom control point.

The dispatcher informed us that there was a bad weather situation at the airfield: there was a pouring rain, and visibility was extremely limited. Nature had not been kind to us. But the greater the number of difficulties, the more composed did the crew become, and the more efficiently did the work proceed. "We must land the craft in an excellent manner, we must land it in such a way that the Londoners will say: 'There's an aircraft! That's a landing for you!' " That's what I was thinking and that's what ev-



At the London Central Airport.

ery member of our crew was thinking.

We pass Epsom at an altitude of 1200 meters with a course angle of 290°, exactly as we were being ordered from the ground. We head towards the airfield. The rain is becoming heavier and heavier. Streams of water, as though from a hose, lash against the aircraft, and pour against the glass of the cabin. Nevertheless we managed to spot the airfield, which, according to the dispatcher's instructions, we were crossing at an altitude of 600 meters. For a minute concrete strips and large buildings in the center of the field appear out of the fog. I notice chains of yellow lights extending straight along the landing strips.

The most critical stage of the flight begins — the approach for a landing and the landing itself.

With a right turn we bring the aircraft onto a landing course of 150°.

Before the moment of touchdown I am possessed by one thought: Land the machine neatly and reduce the length of the run to a minimum. Out of the corner of my eye I see a large collection of automobiles around the airfield. I conclude that in spite of the rain many people had come to welcome the guests from the Soviet Union. This inspires me even more to make an excellent landing.

The aircraft descends headlong. One hundred ... fifty ... twenty meters are left till the ground. The landing strip rushes straight up towards us. We bring the craft up to the touchdown line, and gently contact the concrete with our main wheels. And counting on the fact that high angles of attack shorten the length of the run, we try, during the first half, not to bring the craft down on the front pair of wheels. This is accomplished successfully. In this two-point position we applied the brakes as well.

As a result, we completed the run very quickly — so quickly that the British, as we found out later, were literally astonished at such qualities in the Soviet TU-104 aircraft. We found out, only after we had taxied into the place assigned us by the airfield administration, how many eyes had been directed at our aircraft.

Hardly had we landed, when people started welcoming us and showering us with

questions. Most of the questions were very concrete and this led us to the conclusion that many of our interlocutors were experienced specialists in the business of aviation. One, for example, an aviation engineer by profession, examined the front landing gear strut and pair of wheels and then asked us how such good maneuverability of the aircraft was achieved during taxiing. I explained that in the cockpit there is a control wheel with which the front strut of the landing gear is directed. He pointed to the front wheels of an automobile standing close by and turned an imaginary steering wheel with his hands; upon receiving confirmation from me that it was precisely according to that principle that the control of the forward landing gear of our aircraft had been constructed, he stepped aside and started to write down some notes.

Our press reported on the impression that our jet passenger aircraft made on the people of London. We shall cite only a few excerpts from the English newspapers of the time. Here, for example, is what the London newspaper, the "Daily Mail" wrote on 23 March 1956: "Gentlemen, you can whistle — the excellent streamlined aircraft TU-104 has arrived ... It landed slowly and gently, and it maneuvered over the reception area of the London Airport with the noise characteristic of a 'Comet' ... Civilian and military experts, having gathered to have a look at it, were at first taken aback with silent amazement and then, in astonishment, they whistled".

And further: "The shock of the British and American experts was caused by the fact that this aircraft is ready for exploitation and gives Russia a leading position in civil aviation. It is generally acknowledged that England would be in the same ranks or ahead, if the 'Comet' had not had accidents. But it did have. And we cannot return a jet passenger aircraft to service before 1959, while the Americans cannot obtain such an aircraft before 1960 or even later".

On the same day, another London newspaper, the "Daily Express" informed its readers: "Yesterday a new Soviet jet aircraft arrived in London, which has quashed any notion that Russia is lagging behind in the struggle for supremacy in the field of aviation".

There were many similar statements.

The London Airport has six concrete runways, each of them in constant use. The presence of six runways makes it possible to take off and land in accordance with the direction of the wind. Moreover, such an airfield makes it possible for the airfield to receive and dispatch a large number of aircraft.

The British completed the London Airport quite recently, only a few years ago. The primary facility for insuring landing both by day and by night is a radar landing system. We can here note some of the special features of the landing facilities. As is well known, we have two beacons: the outer and the inner. They have one homing station. It stands in line with the runway at a distance of up to 8 kilometers from its edge. Markers are located between the homing station and landing strip; they do not give the direction of flight but fix the moment of passage over each of them and at the same time indicate the distance remaining to the runway. The system of marker stations is determined by the fact that radar guides the aircraft up to the moment of touchdown.

The provision of illumination for flights has been set up in a unique fashion at the London Airport. The approach lights are on both at night and, during adverse weather conditions, in the daytime as well. They begin two kilometers from the runway. The central line of lights is located on a line with the runway. At definite intervals, transverse lines of lights stretch out from the central line; in the event that the aircraft deviates from the course while approaching for a landing, these transverse "horizons"

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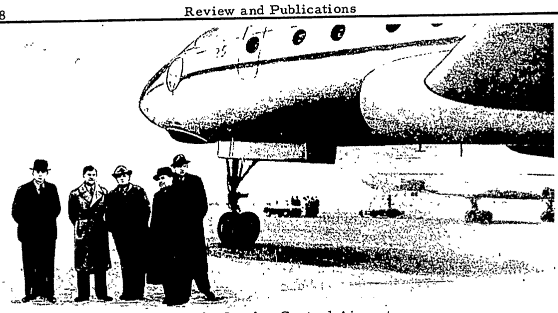

At the London Central Airport.

ery member of our crew was thinking.

We pass Epsom at an altitude of 1200 meters with a course angle of 290°, exactly as we were being ordered from the ground. We head towards the airfield. The rain is becoming heavier and heavier. Streams of water, as though from a hose, lash against the aircraft, and pour against the glass of the cabin. Nevertheless we managed to spot the airfield, which, according to the dispatcher's instructions, we were crossing at an altitude of 600 meters. For a minute concrete strips and large buildings in the center of the field appear out of the fog. I notice chains of yellow lights extending straight along the landing strips.

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From the windows — or rather we shall call them glass walls — of the tower, all the aircraft arriving at the airport were visible. Even earlier we had heard a great deal about the British jet passenger aircraft "Comet". This craft had been operated for some time on the air lines, where, indeed, its negative features had come to light; but we were interested in it nonetheless. At that time we did not manage to spend any time inside the "Comet" and to become acquainted with it closer at hand; but later, during the air show in Moscow, the British granted us such an opportunity. They had brought the British delegation in a "Comet" to the celebration of USSR Air Fleet Day.

The crew of the "Comet - 2" consisted of two pilots, a navigator, a radioman, and an engineer. The crew was provided with considerably less space than the crew on the TU-104. Visibility from the cockpit was a little worse than on our aircraft, particularly towards the sides. The windshields have mechanical window-wipers. The side panes of the canopy can be opened, and this facilitates landing.

The pilots' instrument panel has three sections. The central section is occupied, on the whole, by control instruments for the power plants. The instruments for the left-hand and right-hand pilots are distributed in identical order.

The engines are started up in accordance with instructions. The pilot, the engineer, and a technician take part in starting them. They read an item in the instructions, switch on some mechanism, read another item, and carry out the next action in turn. With such a system they sometimes spend up to 5 minutes getting an engine started. The Englishmen themselves poke fun at their system for starting the engines, but the system is fixed and no one has the right to deviate from it.

We inspected the "Comet" during the period that the aircraft was being serviced for the flight over Moscow. We spent 40 minutes in the aircraft, but the pilots never did manage to start the engines. The ship commander then came out and apologized for the fact that the flight would not take place. The next day, this plane left for London and in its stead, the English sent another one. The proposal was made to me that I act as a pilot in this plane during the flight over our territory. I sat in the seat of the right-hand pilot, and Col. Bagrich and Sgt. Belyayev at the posts of the navigator and radioman.

That is our impression of the "Comet". This aircraft did not pass its tests and was not allowed to be exploited by the transportation and passenger aviation companies of England.

Upon our return to the Motherland, we soon found out that our crew was to fly to India and Burma. We were made extremely happy by this news; we started preparing excitedly for the flights to these friendly countries, and we shall tell about it in the next article.

COMPLIMENTS OF THE COMMANDER-IN-CHIEF OF THE AIR FORCE TO PARTICIPATING WRITERS OF THE PERIODICAL

For their active work in improving the caliber of the periodical, "Herald of the Air Fleet", the Commander-in-Chief of the Air Force, Marshal of the Air Force K. A. Vershinin has in an order conveyed his compliments to Lt. Gen. of ITS [Engineering-Technical Staff] V. S. Pyshnov and to Maj. Gen. of the Air Force M. P. Stroyev (ret.); and to the following officers: A. D. Alekseyev, Ye. I. Annenkov, V. F. Bolotnikov, V. A. Bykhal, B. S. Vinnik, V. A. Galaktionov, D. F. Goldyrev, A. F. Dubovitskiy, A. I. Zadorozhniy, N. S. Zatsepa, A. V. Kuznetsov, N. I. Listvin, N. M. Rudnoy, L. I. Savichev, G. G. Semenko, N. P. Solov'yev, A. P. Fedosov, L. M. Shishov.

The Commander-in-Chief of the Air Force has expressed his kind wishes to all the writers, consultants, members of the editorial staff, and contributing correspondents for productive work in further improving the caliber of the publication.